FOREWORD

The Naval Junior Reserve Officer Training Corps (NJROTC) Multi-Text has been prepared by the Chief of Naval Education and Training to provide a consolidated text at the appropriate reading level for sophomore NJROTC cadets.

The material in this text is intended to provide the subject matter necessary to accomplish the following objectives:

To develop informed and responsible citizens

To strengthen character

To promote an understanding of the basic elements and requirements for national security

To help form habits of self-discipline

To develop respect for and an understanding of the need for constituted authority in a democratic society

To develop an interest in the Military Services as a possible career

This multi-text is a synthesis of ten Navy training books and pamphlets used in the NJROTC curriculum. The principal contributors to the text are professional educators who are members of the Chief of Naval Education and Training Headquarters Unit 423, a reserve unit tasked by the Chief of Naval Education and Training Support (CNETS) to develop text materials in support of the NJROTC program. It reflects the findings of a study made by the Naval Reserve FMAD-6-1 in Tampa, Florida and the recommendations of numerous Naval Science/Assistant Naval Science Instructors in the field.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

PART A

ORIENTATION AND SEA POWER

In this section, you will begin to learn the most basic and elementary information about the Navy and its importance.

Everything that you learn through the NJROTC program will revolve around this basic naval orientation. You will begin by learning the specific objectives of the NJROTC program itself. Also, you will study how to recognize ranks and special markings which tell what special job each navy man does. You will learn about the many customs and traditions that have developed in the Navy over the years.

After you have studied the basic naval orientation, you will look more closely at just how the Navy is organized. You will study the various offices and sections of the Department of the Navy and how they fit together and work together. You should also learn to appreciate how the naval organization relates to the security of our country. Things like intelligence, research, and strategy will mean more to you after you have studied how the Navy is organized.

Later in this part, you will take an even closer look at naval operations. This will explain to you how a large Navy really works. You will learn how units in the Navy communicate with one another and how they can move and work together toward a military objective. You will see exactly how the Navy operates as a whole and in groups of units or ships. You will also learn how a ship is organized and all the things it takes to make the ship go.

Most of the study material for this part will be contained in this text. Those sections on naval heritage and customs and the sections on Navy rates, grades, and insignia will be found in chapters 3 and 4 of *Basic Military Requirements,* NAVEDTRA 10054 (Series).

SEA POWER

Sea power is a term used to describe the capability of a nation to use the sea. Here is the definition used by the Chief of Naval Operations.

> "Sea power is the sum of a nation's capabilities to implement its interests in the ocean, by using the ocean areas for political, economic, and military activities in peace and war in order to attain national objectives–with principal components of sea power being naval power, ocean science, ocean industry, and ocean commerce."

Our present idea of sea power started with Captain Alfred Thayer Mahan's use of the term in his famous book. *The Influence of Sea Power upon History, 1660-1783.* In this book, Captain Mahan examined the great sea powers of the past, especially England. He observed that the great maritime nations had six characteristics in common.

1. Geographical position, which he described as the most important factor in the rise of English Sea power. England was ideally located near the sea lanes of European trade. From this position, she grew rich by trade in peace. In war, she could deny these routes to her enemies. Being an island, she was also protected from easy invasion by neighbors, so she did not have to support a large peacetime Army.

2. Physical conformation, including natural resources, products and climate. Mahan observed that geographical position cannot help if the nation does not have an adequate coastline with good harbors. Also, if the country has enou resources and good climate for crops, she w not use the sea. England developed her maritin resources because she lacked many of t necessary things at home.

3. Extent of territory, which must not too great to defend or offer many oth opportunities therefore sacrificing maritir interests.

4. Size of population, which interdependent with the extent of territo England's population was large enough provide adequate armies and navies to defe her shores against even larger nations.

5. Character of the people, which mea that the people of the country are willing to p up with the hardships of life at sea.

6. Character of the Government a national institutions, which is to say t government must guide the existing natio features and channel these traits ir development of maritime power.

At the time Captain Mahan wrote his boo American National policy had reduced the U Navy to the role of coastal defender a commerce raider. National policy stres westward expansion–the development in inla regions.

Mahan's writings and his doctrine of power helped those in the Navy a Government who wanted to make the countr maritime power. They were able to use lessons of history to explain the relat between the strength and prosperity of a nat and its sea power. As Mahan did, let us also lo at some of the history of sea power.

EARLIER SEA POWER

One of the earliest examples of sea power was 4000 years ago. At that time, the ancient Cretans controlled a navy and merchant marine that dominated the shores of the Aegean Sea–now Greece and Turkey.

A little later, the Phoenicians prospered from a mastery of the sea. They are often called the real pioneers in the use of sea power. Their ships dominated the eastern Mediterranean for several hundred years.

In 492 B.C., Persia was dominant on the seas and attempted to conquer Greece. The Greeks were able to repel them on two occasions, but the Persians were still a threat from the sea. On the advice of an oracle, the Greeks built a fleet of fighting ships. In the battle of Salamis in 480 B.C., the smaller, but better led, Greek fleet outmaneuvered and defeated the Persians. The Persian King, Xerxes, gave up his attempts to conquer Greece. A period of peace and productivity in science and arts followed. This was the Golden Age of Athens, and lasted as long as the Greek naval and merchant fleets were strong.

Rome succeeded Greece in power, but soon was challenged by a powerful maritime rival. This was Carthage, which had been a Phoenician colony. The rivalry grew into the Punic Wars, and Rome began to seriously develop a Navy. The Carthaginians were fine sailors, but the Romans were clever engineers. Their larger fleet, with newer weapons, led them to victory.

The Roman Empire also prospered with sea power. Her ships transported and maintained troops over the Mediterranean, and as far away as England.

As Rome declined, Constantinople–now Turkey–rose in power. It held the key to the Bospurus, the waterway between Europe and the near East. Renaissance Venice was next to become a great sea power along with the Moors who controlled most of the Mediterranean.

The powerful sea-going Moors exacted tribute as the price of the trade and passage. This practice was abolished with the help of American sea power 350 years later.

The age of exploration and colonization was an age of sea power. All the peaceful and warlike aspects of sea power were exercised as Portugal, Spain, Holland, France, and England expanded their empires, the extent of their trade, and their national power on and across the seas.

As a more powerful country, Spain soon surpassed the adventurous Portuguese on the sea. From her discovery of America until 1588 she was the most powerful nation in Europe. But Spain was a classic example of sea power expressed in quantity rather than quality.

In 1588, the King Philip II of Spain decided to end the aggravation of English raids on Spanish ships and ports. He intended to land an irresistable military force to conquer the English. His fleet of 124 warships was manned by 8000 sailors and carried 19,000 soldiers, along with their equipment and horses. It was opposed by 90 armed British ships, and a number of smaller craft.

The English ships were manned with experienced seamen, ranging from fishermen to blue water sailors. Many had experience in fighting the Spanish at sea.

The Spanish Armada was organized as an army. It was commanded by a general. His concept of a sea engagement was to ram an enemy ship and capture her with soldiers.

The smaller English ships avoided the Spanish style of fighting. Under the command of an expert sailor, Sir Francis Drake, they kept their distance and used their guns.

The conflict was not dominated by either side, although at one point the English were joined by the Dutch fleet. If the combined fleet had not been short of powder and shot, it might have seriously damaged the Spanish force. The English harrassed the Spanish, who did not dare attempt a landing of their army. Demoralized, the Spaniards sailed north to the stormy waters above the British Isles. There many ships were lost, and the Armada's defeat was completed by the sea.

With Spain's grip on the sea weakened, England's ships continued to enrich and protect their homeland, and English sea power dominated the oceans.

The French were not forced to use the sea the way the British, Dutch, and Portuguese were Their land was rich, and had to be guarded against jealous neighbors. The French did not like to spend money on ships. Captains of warships had to follow a policy of avoiding risk.

In the end, this policy cost France her Navy, her Merchant fleets, and most of her colonies. Fortunately for the United States, there was still a French fleet at the time of our revolution.

The final battle of the American Revolution at Yorktown, would not have decided the conflict had the French fleet not commanded the seas in the area. They prevented a British fleet from reaching Cornwallis, who was surrounded by French and American forces. He was forced to surrender.

General George Washington understood the importance of sea power, and through the Revolution made the most of our meager resources. His statement on the subject was:

> "Whatever efforts are made by the land armies, the Navy must have the casting vote in the present conflict...A constant Naval superiority would terminate the war speedily; without it, I do not know that it will ever be terminated honorably."

Napoleon was a master strategist on land, but he had little knowledge of war at sea. "The great weakness of our Navy," he said, "is that the men who command it are inexperienced in all the hazards of command. I look increasingly for the right naval officer without being able to find him. In that profession there is a specialty, a technicality, which puts a limitation to all my conceptions."

The British use of sea power in the Napoleonic wars is characteristic. The combined land forces of Britain and her allies finally crushed Napoleon's armies. But sea power had been working relentlessly to weaken the French, protect the English, and move their military strength where it was needed. Sea power allowed the forces of Sir John Moore and the Duke of Wellington to engage the extended flank of the French in North Africa, Spain, and Portugal. Sea power shifted these same forces at the right moment; north to Flanders to out maneuver the French army. British land forces were always much smaller than Napoleon's grand army. Napoleon's strategy, however, required troops stationed throughout Europe. The entire British force could strike any coast it chose. Sea power gave the mobility needed to use the army to it advantage.

In our civil war, Northern sea powe contributed to victory. The Navy was able t reduce Southern foreign trade to a trickle b means of a blockade. Naval forces supporte army landings on southern coasts and along th Mississippi. In spite of skillful and darin operations by southern commerce raiders an blockade runners, the south ran out of vit materials while Northern commerce move almost at will.

SEA POWER IN MODERN TIMES

World War I was much like the Napoleon Wars in that it was a struggle between a stror land power and a strong naval power. Tl British Navy, rather than the French Army, w the principal barrier to German success. correct appraisal of this situation, as early 1905 when Germany began to build up her nav strength, might have resulted in a German Nav strong enough to defeat Great Britain's. As was, Germany's leaders were land minded, ar the Imperial Army was the favored service. Th fact caused Admiral von Tirpitz to lament, "V Germans do not understand the sea!" Too la the U-boat force was recognized as Germany deadliest offensive weapon. Measures were tak to expand the naval arm, but it was too late.

In World War II, the Germans once mo demonstrated shortsightedness and inability make the best use of their resources in s power Again they failed to build an adequa number of ships. But even so, if the Axis Powe had correctly estimated the strategic importan of the Mediterranean, and if they h concentrated all possible naval resources wi the Italian fleet as the main striking force, t Mediterranean might well have become an A lake. Under such circumstances, the Alli African campaign would have faced very gre difficulties.

At first England held the upper hand in t Mediterranean while our own power was bei assembled. Later, with the combined strength our sea power, we conducted the gre amphibious compaigns that were each

stepping-stone to final victory. These were North Africa, Sicily, Italy, Normandy, and the Mediterranean coast of France.

In the Pacific, with local control of the sea, Japan captured Singapore, the Western Aleutians, the East Indies, the Solomons, and threatened Australia. When she lost this control, she was unable to send men, supplies, and ships to the aid of Okinawa, which was very close to her homeland. In the first years of the war, our range of operation was limited. As we reduced Japan's Navy, and as our own grew, it became possible to range more freely, and recapture parts of the "Island Empire".

Because of sea power, our landings in Leyte and Lingayen were ahead of schedule. Inability to move on the sea prevented the Japanese from exploiting their strength in the Philippines, and reinforcing their troops at our point of attack. Control of the sea made it possible for us to bypass many islands and avoid waters controlled by the enemy.

Sea power permits multiple use of the same force; a small army becomes, in effect, many armies. With a handful of divisions, the Pacific Area forces drove steadily toward the Japanese home islands. In much of the central and western Pacific, the Japanese had a strong superiority in numbers, but a large portion of her troops never got into combat. Without adequate shipping, the Japanese legions were helpless. With enough shipping, our few divisions were superior to the many that opposed them.

SEA POWER AND NAVAL BLOCKADE

Sea power means more than controlling the seas for one's use. It means denying their use to the enemy. This can be partly accomplished by a blockade. A blockade is the closing of the sea roads to starve the economy of the nation. Some understanding of the effect of a blockade can be gained from figures released in a report from General MacArthur's headquarters in Japan following World War II.

The peak wartime production of steel ingots in the Japanese Empire occured in 1943, when approximately 9,600,000 tons were produced. By 1945 Japan's steel industry was producing at the rate of only 120,000 tons a year. The report further indicated that 1,800,000 tons of the annual capacity were erased by bombing. How then, can we account for the remaining 7,680,000-ton loss in production? The answer? Naval blockade.

In 1941 a total of 4,000,000 tons of iron ore was required by the Japanese steel industry. Of this, some 3,000,000 tons had to be imported from the Asiatic mainland and from the Philippines. As the naval blockade tightened, imports dropped off, and by 1944 the iron content of imported ores added up to less than 30 percent of the tonnage imported in 1941.

THE EVOLUTION OF SEA POWER

Captain Mahan's doctrine was written for the world of the 19th century. Many political and technological changes have occurred since the doctrine was published. Some elements of sea power have changed too.

The British Empire that Mahan studied has declined, and its maritime power is reduced. The days are past when a motherland is enriched and supported by its colonies. Mahan never knew of the military use of the submarine and the airplane. He considered the struggle for sea power supremacy as centered in the Atlantic Ocean. But World War II was fought as much in the Pacific as the Atlantic. Because of these changes, we must re-examine the meaning of sea power in terms of modern technology and world economics.

History shows no major nation that has been economically self-sufficient. As in the past and present, and probable future, nations will need the natural resources and goods of other nations.

These goods must be transported from their source to where they are needed. Water transport is the only way to move large bulks of materials between some points. More than 99 percent of all international trade moves on the sea.

Aircraft can carry urgently needed items to most parts of the world, but it is costly.

Use of the sea as a means of transport implies a control of the sea. This is particularly true when unfriendly powers wish to oppose

such transport. Thus, the primary mission of our Navy is to gain control of the sea for our use.

It also must control the use of the sea to our enemies. Once in control of the sea, the function of the Navy is to use the sea to aid in achieving our military and political aims. In this age, control of the sea means control of its surface, its depths, and the air above it. Military control is not enough by itself. In addition, sea power means we must have commercial ships to bring the supplies we need, and other ships to fish, to obtain sea bed oil, and otherwise make use of the sea's resources.

THE CURRENT WORLD SITUATION

The Navy's current responsibilities, set forth in the Department of Defense Reorganization Act of 1958, include things not even thought about at the turn of the century.

The primary functions of the Navy and the Marine Corps are to organize, train, and equip Navy and Marine Corps forces for conducting a prompt and continued combat operation at sea. This includes operations of sea-based aircraft and land-based naval air components. These forces shall seek out and destroy enemy naval forces, suppress enemy sea commerce, gain and maintain general naval supremacy, control vital sea areas, protect vital sea lines of communication, and establish and maintain local superiority (including air) in an area of naval operations as may be required to a naval campaign

The Navy also provides joint amphibious operations and is responsible for training all forces assigned to these operations in amphibious doctrine. Other specific responsibilities assigned to the Navy are naval reconnaissance, antisubmarine warfare, protection of shipping, mine laying, and controlled minefield operations. With the other services, the Navy must provide forces for the defense of the United States against air attack.

It is easy to see that the Navy's mission has become more complex since the time of Mahan. Accompanying this increased mission has been the significant material and technological growth of the modern Navy.

The Navy has entered a new phase o scientific warfare. Now, nuclear weapons an guided missiles are the primary destructiv weapons. Armed with guided missiles, the Navy with its Marine component, is capable c deployment in a timely fashion wit conventional weapons and force necessary t control a limited war situation and prevent th outbreak of a major war.

The Navy's current scientific projects rang from earth navigation and communicatio satellites to the improvement of nucle propulsion. The Navy's Polaris missil operational in nuclear-powered submarines sea, was the first missile in the IRB (Intermediate Range Ballistic Missile) to emplo the solid propellant motor. Other missi programs are following the lead of the Polaris.

Other Navy achievements inclu pioneering the route from the Pacific to t Atlantic beneath the North Polar ice cap, ne developments in communications, rad underwater acoustics, oceanography, and ma other scientific advances.

Historically, a Navy's radius of action w s limited to the enemy's coastline, plus the ran e of the ship's gun. With the development of hi performance aircraft and ballistic missiles, t e Navy's radius of action now spans continents.

Ships, because of their mobility, are not t e accessible targets that shore bases a . Furthermore, as a partial deterrent to t e destructive capabilities of nuclear weapons, t e dispersal concept has been added to Fle t doctrine.

Mobility is the Navy's greatest safegua d against modern weapons. The ocean areas of t e world make up almost three-fourths of t e earth's surface. The defensive position of a force is thereby very large. But, because o a navy's freedom to travel these vast sea roa s, and its ability to range close to the ene y, attack becomes more accurate.

A sea blockade eventually breaks dow a hostile nation's economic system. But ur Navy's paramount objective in wartime is o maintain control of the seas for ourselves a d our allies, and to destroy all the enemy's a power. This includes the part resting at his bas s. Should it fail to achieve this goal complete y,

the Fleet will still provide a distant line of defense as far from our shores as possible.

Such a line of defense, composed of surface ships, submarines, and aircraft, is both effective and economical. Its principal strength lies in its ability to shift readily from defense to offense without long preparations.

At the international level, our treaties of mutual defense bind us to the defense of distant parts of the earth. These may be distant but are reachable by moving over the sea. These treaties represent a voluntary association of free men to meet the potential attacks of nations hostile to our way of life.

In the Caribbean, an amphibious ready group with an embarked Marine Corps battalion landing team is on station to maintain the stability of that area. A battalion of Marines also is stationed in Guantanamo on the Cuban Island for the security of the naval base.

Four American fleets serve the Navy's basic mission of protecting national security. The Second Fleet operating from the world's greatest naval base at Norfolk, Virginia, patrols the western Atlantic across some of the world's most important trade routes. Ships and men of the Second Fleet rotate with those of the Sixth Fleet, which moves in the nearly landlocked Mediterranean Sea We could describe the Sixth Fleet as "keeper of the doors."

The Mediterranean has been a crucible for the mixing of men's affairs since the dawn of history, and it is no less so today. Gibraltar, the front door of the Mediterranean, is a vital commercial choke point. Whether it is open or closed, it affects the destiny of nations. And, lest we forget, there is a side door to the Mediterranean–the Bosporus and Dardanelles–through which ships come from the land of the Soviets.

During the Arab-Israeli war in June 1967, there was a marked increase in the size of the Soviet Mediterranean Squadron. From a previous high of 23 ships, Soviet naval strength rose from 35 to 40 vessels. It was the first time in recent years that the Soviets have so deliberately used their fleet to support their foreign policy. Since this was in the Mideast, a stepped-up program of Mediterranean port visits by Soviet ships seems clearly aimed at increasing Soviet influence in that area. The level of Soviet naval activity provides additional reasons for the continued presence of a strong Sixth Fleet. In spite of heavy commitments elsewhere, the Navy has maintained the Sixth Fleet at its pre-Vietnam levels. It is built around two attack carriers and an amphibious striking force with an embarked Marine Corps battalion landing team. The rate of deployment of anti-submarine hunter-killer groups to the Mediterranean from the Atlantic has been increased because the Soviets maintain a submarine force in the Mediterranean.

Across the world from the Mediterranean, the First Fleet, operating off the west coast of the United States, trains and shakes down the men and ships that will rotate to the Seventh Fleet in the vastness of the Pacific.

COMMERCE AND OCEANOGRAPHY

To this point, the theme has been raw sea power. Naval power is only a part of total national sea power. Since the ocean is the Navy's operating environment, the Navy is necessarily concerned with all of the Nation's interests in that environment. There are many other sides to the term "sea power" that could be mentioned here, but two certainly must be considered. One, maritime commerce (mentioned several times previously), has been in existence for thousands of years. The other, study and use of the sea itself, is a recent undertaking.

MARITIME COMMERCE

We have said that one of the main functions of a country's naval forces is to control the sea. Particularly in wartime, command of the sea includes keeping the sea lanes open to friendly shipping and denying their use to an enemy.

There was a time in American life when we believed we were independent of other nations. Our increasing population and growing rate of consumption of practically every commodity has completely changed this concept. Today we are dependent on other nations for a large part of what we need to keep our economy strong, to keep our people at work, and to manufacture what we need.

There are no less than 77 resources that the United States cannot do without if we are to maintain our present economy. To cite a few examples, we must have manganese to make steel, but we import 85 percent of our needs. Of columbite, used in the construction of nuclear reactors, as a stabilizer in stainless steel, and for the manufacture of rockets and missiles, we import 90 percent. We import 86 percent of our bauxite (bauxite is the ore from which aluminum is refined). We import 90 percent of the chromite used to toughen steel. We import more than 99 percent of the tin we need. We annually consume one-third of the entire world supply of oil.

Almost half of the free world mineral production is channeled to the needs of our industrial machine. Of the 77 resources considered vital to America, only 11 are found within our own borders. In other words, we are a raw-materials-deficit nation, dependent upon waterborne commerce to bring to our shores, from all corners of the earth, many primary products essential to our industrial system. We could not produce enough planes in generations to move all the goods that now travel by ship. In this context, each of our states individually depends on shipping. Illinois, for example, probably first in exports of farm products, is among the first in imports of other commodities. On the other side of the coin, foreign nations depend on American raw materials to maintain healthy economies at home.

The doctrine of freedom of the sea is acknowledged by all nations under international law. Whatever the law of the sea, when nations fight they cross the sea at their own risk. The forces of each will do their utmost to deny passage of commercial shipping to the other(s) whenever and wherever they can. Throughout all history, the great and powerful nations were those able to protect their own ships. From ancient Persia to recent Japan, empires fell when they could not do so.

Because a strong American defense posture depends upon a modern, highly productive industrial system, shortages of essential raw materials would strike a blow at our national security and to the health and stability of our domestic economy.

To ensure national security and keep up the economic vitality of 200 million Americans, it is of critical importance that:

1. Raw materials from throughout the world be fed into the U.S. industrial machine by waterborne commerce;
2. Manufactured products be moved onto the world marketplace by ocean shipping, and
3. Sea lanes be kept open and secure in time of peace and tension, and denied to our enemy in case of war.

OCEANOGRAPHY

Another area of national interest lies in the way man looks at the ocean. Seventy percent of the earth's surface consists of salt water. Although different parts bear names, all the oceans on earth together form a single sea some 40 times the size of the United States. At varying depths extending to thousands of feet, live more forms of animal life than upon dry land. We know that many minerals are available beneath the waters. We have always known food to be there, and this knowledge could be a vital element of future survival.

Man is increasingly turning to the sea for new resourses. Only time will tell what man's ventures on the floor of the sea will bring. This technology may offer a whole new world to us. Already, an oil field on the ocean bottom has been conceived where men can go, work, and live. The science of aquaculture may in time make it possible for underwater farms where plants and fish are cultivated and processed for a hungry world.

The sea has become the birthplace of the age of oceanography. To explore the sea, the Navy has an oceanographic fleet of surface ships and submersibles that study the nature of the sea. They study the wind, weather, and migration of fish. They listen to the sounds within the waters to improve sonar for antisubmarine warfare, and find ways to communicate from the ocean depths.

The knowledge and technology gained by the Navy in conducting its security mission will contribute to this expansion into the ocean. The Navy, will exert a large influence on the move to utilize the sea. It appears certain that new Navy

missions, tasks, and capabilities will develop. The Navy will require a capability to operate anywhere in the worlds ocean at any time. Scientific knowledge of the ocean has become necessary to operations as a global sea power.

The seas belong to all men and all nations. Just as the protection of great navies helps seaborne commerce, today the Navy uses its sea power to protect and encourage the right to explore and prospect this newest of man's frontiers on earth.

CONCLUSION

Balanced sea power is a necessary ingredient of good national strategy. Sea power is a blend of peaceful and warlike powers. In the military sense, it is not constrained to any one course of action. Our naval forces can contribute greatly in any area of warfare, from counter-insurgency up to and including general war. Exploitation of the sea as an effective dispersal area is increasingly desirable and necessary.

The forces of today's Navy can meet any type of aggression, from the most sophisticated to the most primitive. The variety of ways in which our naval forces can respond is itself a strong deterrent. If deterrence fails, however, these same forces will permit the United States to control a conflict within selected limits or to escalate the conflict, if it becomes necessary.

By remembering the lessons of World War II, Korea, Lebanon, Cuba, and Vietnam, we have learned that strength has a logic of its own. Just being right is not good enough. It takes might to preserve that right. The power of our fleet reflects the power of the land it must defend and of all lands that join with us in a common need. The United States Navy is a result of past lessons learned, of a troubled present, and of an unpredictable future.

ORGANIZATION OF THE NAVY

The Department of the Navy, along with the other components of the Department of Defense, is dedicated to the defense of our country. Naval forces are dispersed worldwide–on land, on and under the sea, and in the air. To manage these widespread forces requires a high degree of organization. This chapter gives you an overview of basic organization of the Navy and of the standard shipboard organization.

First let us take a look at the Department of Defense and its responsibilities.

The Department of Defense was created in 1949. It includes the Army, Navy and Air Force military departments and various other agencies. The Department of Defense houses the Joint Chiefs of Staff which consists of the military heads of the Army, Navy, Air Force and Marine Corps.

The Department of Defense manages and directs armed forces to–

1. Support and defend the Constitution of the United States against all enemies.
2. Ensure the security of the United States, its possessions, and areas vital to its interest.
3. Uphold and advance the national policies and interests of the United States.
4. Safeguard the internal security of the United States.

Generally speaking, the duty of each military department is to prepare forces equipped and trained to meet the needs of war or other emergencies.

DEPARTMENT OF THE NAVY

The Department of the Navy and office of Secretary of the Navy were established in 1798. In 1947, the Department became a part of the National Military Establishment. In 1949, the National Military Establishment was renamed the Department of Defense and was established as an executive department of the government.

The goals of the Department of the Navy are (1) to prepare Navy and Marine Corps forces to perfrom their military roles, and (2) assist and support all military forces.

The Department of the Navy is made up of the Navy Department (the executive offices), Headquarters, United States Marine Corps, all operating forces of the Navy and Marine Corps, and their reserve components, and all shore

(field) activities, headquarters, forces, bases, installations, and functions under the control or supervision of the Secretary of the Navy (SECNAV). The Department includes the U.S. Coast Guard in time of war. Figure A-1 shows the basic organization of the Department of the Navy.

NAVY DEPARTMENT

The Secretary of the Navy is responsible, under the Secretary of Defense, for the policies and control of the Navy, including its organization, administration, operation, and efficiency. The function of the Navy Department is to assist the SECNAV in carrying out his responsibilities. Members of the executive administration include civilian executive assistants (Under Secretary of the Navy, Assistant Secretaries, and the Special Assistant to the Secretary), staff assistants to SECNAV; the Chief of Naval Operations (CNO); the Commandant of the Marine Corps, the Judge Advocate General (JAG), the Chief of Naval Research, and the Deputy Comptroller of the Navy. The Chief of Naval Material, Chief of Naval Personnel, and Chief of the Bureau of Medicine and Surgery complete the composition of the Navy Department.

Chief of Naval Operations

The Chief of Naval Operations is the head of the Navy. He is a member of the Joint Chiefs of Staff. He is the principal adviser to the President, the Secretary of Defense, and the Secretary of the Navy, on naval matters. Except for those areas where the responsibility rests with the Commandant of the Marine Corps, CNO has overall authority throughout the Department of the Navy in matters of naval administration. These matters include security, intelligence, discipline, and communications. CNO is assisted by the Vice Chief of Naval Operations (VCNO), by several deputy chiefs (DCNOs) and assistant chiefs (ACNOs), and various program directors. These officers and their staffs constitute the Office of the Chief of Naval Operations (OPNAV).

Chief of Naval Material

The Chief of Naval Material, under CNO, commands all activities of the Naval Material Command. He is responsible for providing the material support of the Operating Forces. He is also responsible for providing certain material support to the Marine Corps. He heads six principal subordinate commands, which are discussed later.

Chief of the Bureau of Medicine and Surgery

The Chief of the Bureau of Medicine and Surgery is responsible for safeguarding the health of Navy personnel. He provides care and treatment for sick and injured members of the Navy and Marine Corps and their dependents. He conducts training programs for medical personnel and maintains a continuing program of medical and dental research. He maintains programs for the prevention and control of diseases, injuries, and occupational illnesses of civilian employees of the Navy.

Chief of Naval Personnel

The Chief of Naval Personnel, under CNO, is responsible for the promotion, distribution, discipline, retirement, religious guidance, and the welfare and morale of officer and enlisted personnel of the Navy. This includes the Naval Reserve and the Naval Reserve Officer Training Corps. He is also responsible for regulations concerning uniforms, ceremonies, and naval etiquette

SHORE ESTABLISHMENT

We will not attempt to list and describe every type of shore activity operated by the Navy. Examples of such activities include naval district headquarters, air stations and facilities, Reserve training units, communication stations, recruiting stations, shipyards and naval bases and stations. We will limit our discussion to a few of the major shore commands.

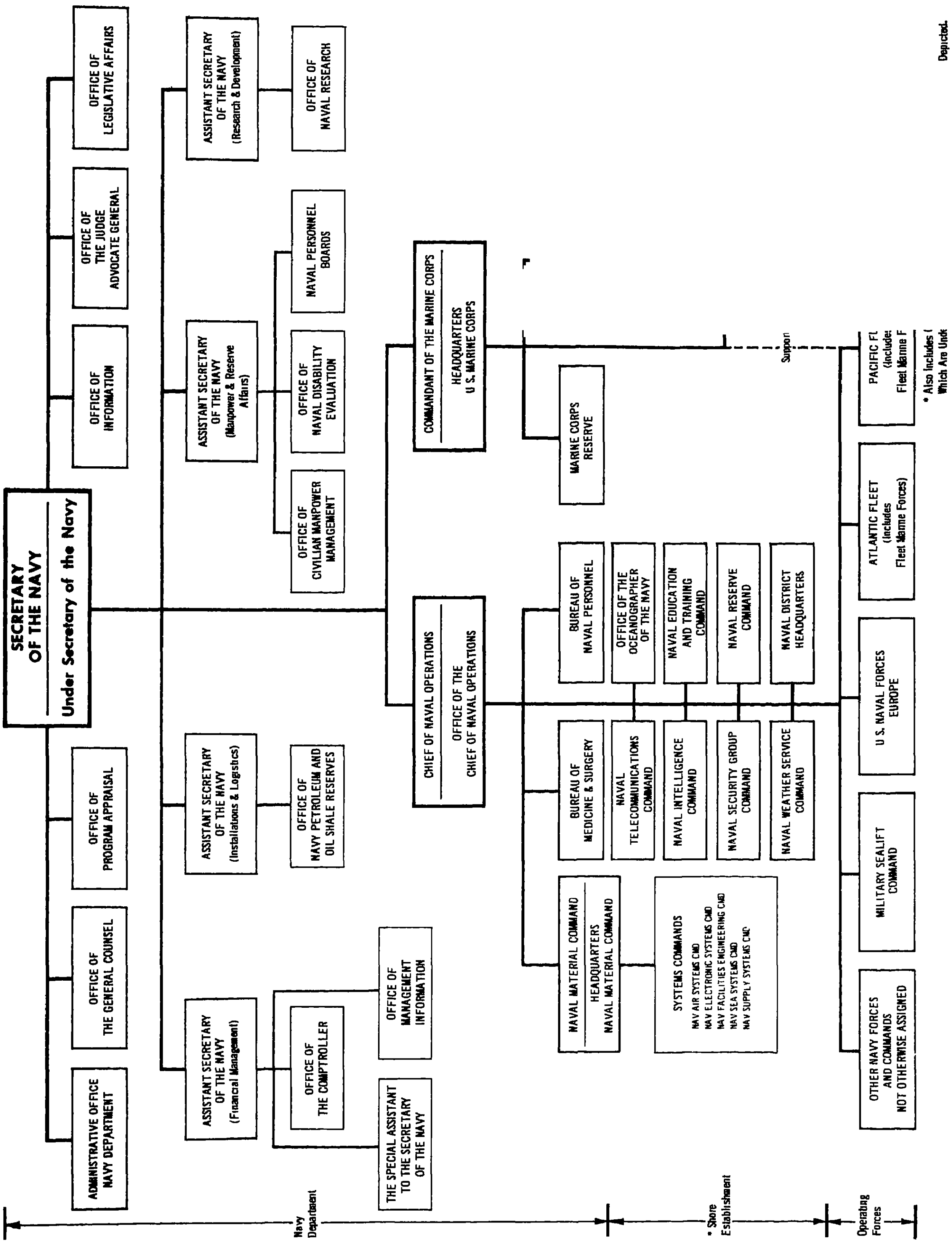

Figure A-1.—Department of the Navy.

Systems Commands

The Naval Material Command consists of five principal subordinate commands, each of which has its own headquarters and shore activities.

1. The Naval Air Systems Command (NAVAIR) is responsible for Navy and Marine Corps aircraft and airborne weapons systems.

2. The Naval Facilities Engineering Command (NAVFAC) is responsible for administration of the Navy military construction program. The Command also provides engineering and technical services within the Navy.

3. The Naval Electronic Systems Command (NAVELEX) is responsible for shore-based electronic systems and certain airborne and shipboard electronic equipment.

4. The Naval Sea Systems Command (NAVSEA) is responsible for ships and their weapons. NAVSEA is the technical authority on explosives, propellants, explosive and nuclear safety, ship safety and salvage, and ship propulsion and control systems.

5. The Naval Supply Systems Command (NAVSUP) is responsible for supply management policies and methods.

Naval Districts

Naval districts are geographically defined areas established by the Secretary of the Navy. Each is headed by a commandant, under the command of the Chief of Naval Operations.

District commandants have responsibilities in the evaluation of the capabilities and readiness of shore activities, furnishing support to fleet units, area defense, and control of local disasters or emergencies.

The fifteen naval districts are shown in figure A-2. The following list shows the location of the headquarters of each district.

District	Headquarters
First	Boston, Mass.
Third	New York, N.Y.
Fourth	Philadelphia, Pa.
Fifth	Norfolk, Va.
Sixth	Charleston, S.C.
Eighth	New Orleans, La.
Ninth	Great Lakes, Ill.
Tenth	San Juan, P.R.
Eleventh	San Diego, Calif.
Twelfth	San Francisco, Calif.
Thirteenth	Seattle, Wash.
Fourteenth	Pearl Harbor, Hawaii
Fifteenth	Balboa, C.Z.
Seventeenth	Kodiak, Alaska
Naval District, Washington	Washington, D.C.

Naval Bases

A naval base includes all naval shore activities in a given locality. The primary purpose of a naval base is to coordinate services provided to the fleet by naval activities. The base commander is under the military command of the district commandant.

OPERATING FORCES

The Operating Forces are composed of the several fleets, sea frontier forces, the Military Sealift Command (MSC), district forces, Fleet Marine Forces, the Coast Guard when operating as a service in the Navy, and such other forces as may be assigned by the Secretary of the Navy. They are under the command of the Chief of Naval Operations, and are composed of combat and service forces.

Sea Frontiers

A sea frontier is a naval command consisting of the sea and land areas of a coastal frontier. There are five sea frontiers: Eastern, Western; Caribbean, Alaskan; and Hawaiian. General tasks of frontier commanders are. control and protection of shipping; search and rescue, harbor defense, continental air defense, operational control of fleet units assigned; establishment and assignment of operating areas

3.2

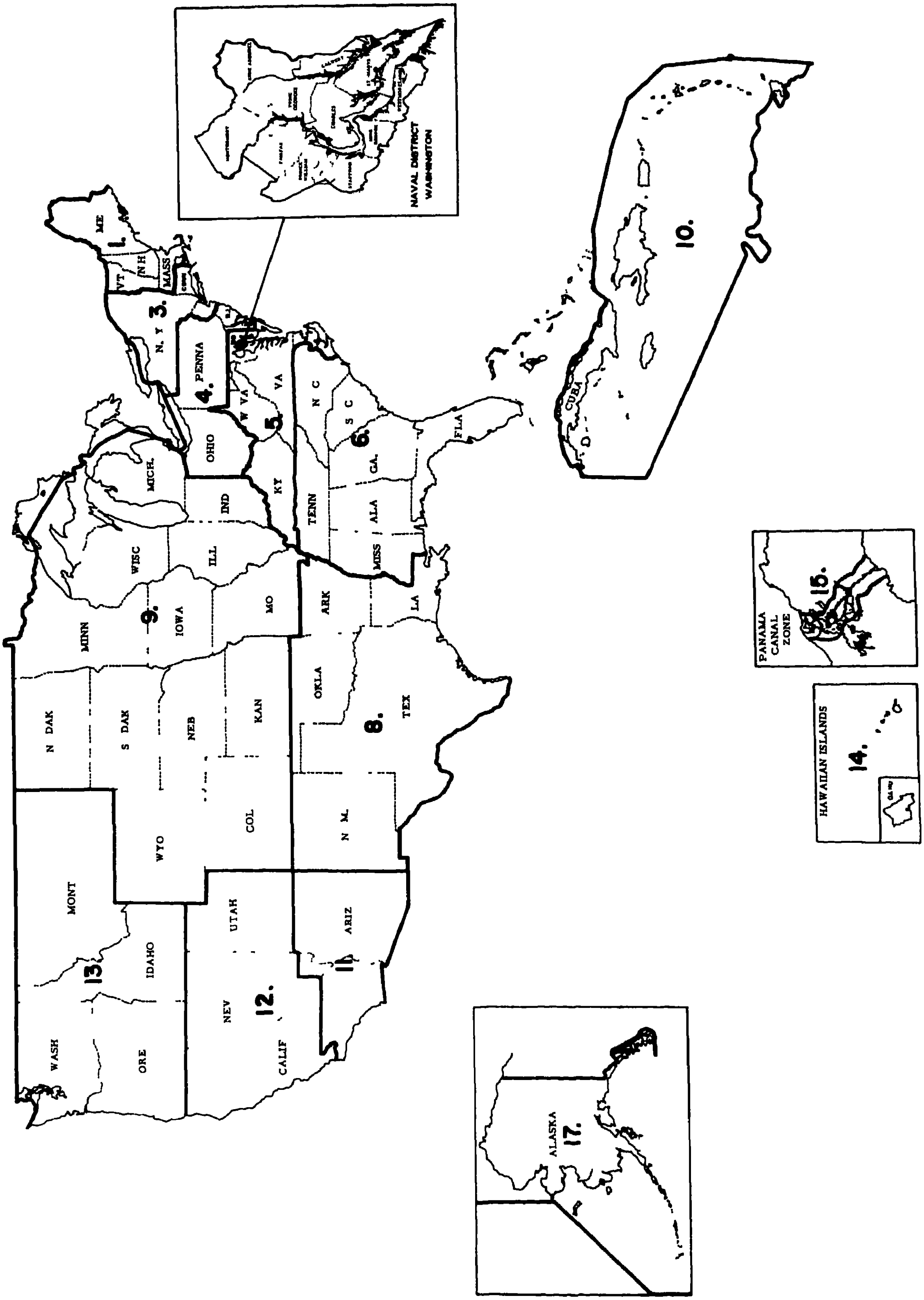

Figure A-2.—The naval districts.

(including air space); logistic and administrative support; and domestic emergencies and mobilization planning. Units of the Naval Air Training Command and the Naval Reserve Command are subject to the operational control of the local sea frontier commander in times of emergency or operational necessity.

Fleets

There are two major fleet commands under the command of CNO. These commands are the Atlantic and Pacific Fleets. The composition of the Atlantic and Pacific Fleets includes all ships and craft operating in the respective ocean.

Operational (numbered) fleets are composed of ships provided by type commanders. In the Pacific Fleet, there are the First and Seventh Fleets; the Atlantic Fleet has the Second and Sixth Fleet.

The Military Sealift Command (MSC) is operated by the Navy for the use of all the services. It consists of civilian manned ships and commercial ships employed on a contract basis. The ships are used for transporting servicemen and their dependents, combat troops, and supplies and material to all parts of the world. The primary mission of the MSC is to provide immediate sealift capability in an emergency. Another function is to support scientific projects and other programs for agencies and departments of the United States.

CIVIL ENGINEER CORPS

Officers of the Civil Engineer Corps (CEC), who administer the work of the Naval Facilities Engineering Command (NAVFAC), are commissioned naval officers having special technical qualifications. They are engineers, planners, estimators, analysts of the Navy's shore facilities, and overseers of the construction and maintenance of the shore establishment. They also command the field forces that construct advance bases for support of Marine and Navy operations

The Commander, Naval Facilities Engineering Command is also the Chief of Civil Engineers (that is, the head of the Corps). He exercises technical direction over the Naval Construction Forces, known as the Seabees. NAVFAC also has support responsibility of commands and organizations (such as construction battalion centers) established as separate activities of the Department of the Navy, whose primary function is the organizing and equipping of the Naval Construction Forces.

In 1946 the Seabees, originally established only as a wartime force, were made a permanent part of the Navy. Construction ratings were established for enlisted Seabee personnel. Prior to that time, there were no construction ratings as such.

The main assignment of early postwar Seabees was to perform work at Navy overseas bases. They also received assignments to perform special missions such as constructing housing at an advance base, or participating in special operations such as the atomic bomb tests and expeditions to the Antarctic.

A Mobile Construction Battalion (MCB) is an independent, self-sustaining unit organizationally designed to operate alone. It constructs roads, bridges, airstrips, fuel storage tanks, water supply system, electric installations and erects buildings. The personnel of an MCB includes carpenters, plumbers, electricians, engineers, surveyors, heavy equipment operators, and other building trades.

The primary job of the Seabees is to build. But they cannot build unless they control the job site, so all Seabees receive training in defensive combat tactics.

THE SUPPLY CORPS

Officers of the Supply Corps are the Navy's business administrators. They are responsible for the vast supply requirements of the Navy. This includes the management of a supply system that must furnish well over a million items required for the operations of ships, missiles, aircraft, and facilities. The Supply Corps officers manage the operation of food service, ship's store, and Navy Exchange facilities. They disburse pay and allowances of Navy men and women.

THE NAVY MEDICAL DEPARTMENT

The term "Medical Department" designates the worldwide medical and dental services and facilities of the Department of the Navy. The mission of the Medical Department is to safeguard the health of the Navy and Marine Corps. This includes care and treatment of sick and injured members of the naval service and their dependents.

THE CHAPLAIN CORPS

The Navy meets its responsibility to provide a religious ministry for its personnel by means of certain activities of commanding officers, chaplains, lay leaders, and the cooperation of civilian religious leaders.

The chaplain is a specialist in the field of religious leadership. He is an adviser to the commanding officer on all matters pertaining to the moral, spiritual, and religious welfare of Navy and Marine personnel. He conducts divine services in accordance with the rules of his own church. Each chaplain is called upon to use his own ideas, techniques, and methods to develop and instill self-realization of the principles of religion, morality, and character in the personnel he serves.

The chaplain is a full-time counselor. He is concerned with home and domestic problems and general welfare. There is considerable demand for the chaplain to instruct young men and women in baptism, confirmation, and marriage. Counseling of this type enables him to carry out a full, rounded ministry. Every chaplain works with men and women who are troubled and worried, and in need of advice and assistance. Men and women both, especially those living away from home, sometimes have the urge to unburden themselves to their chaplain.

JUDGE ADVOCATE GENERAL'S CORPS

The Act of 8 June 1880 established the Office of the Judge Advocate General of the Navy as we know it today. This placed upon the Judge Advocate General the duty of "receive, revise, and have recorded the proceedings of all courts-martial, courts of inquiry, and boards for the examination of officers for retirement and promotion in the naval service, and to perform such other duties as have heretofore been performed by the Solicitor and Naval Judge Advocate General." The Judge Advocate General was given control over all legal matters, of any kind, that affected the interest of the Navy.

Establishment of the Officer of General Counsel was created to take care of matters in civil law. The Judge Advocate General is given responsibility for legal duties and services throughout the Department of the Navy except those specially assigned to the General Counsel for the Department of the Navy. Functions assigned to the Office of the General Counsel are in the fields of business and commercial law.

Public Law 90-179, the bill establishing the JAG Corps as a staff corps of the Navy, was signed into law by the President on 8 December 1967.

All law specialists of the Regular Navy and Naval Reserve were redesignated as judge advocates in the JAG Corps. The statute also provides that the Judge Advocate General may designate qualified Marine Corps lawyers as judge advocates. Marine Corps officers do not become members of the Navy JAG Corps by virtue of such designation.

THE UNITED STATES COAST GUARD

The United States Coast Guard has a double role that is unique among the services By law the Coast Guard is always a military service and a branch of the Armed Forces, but normally operates as a service in the Department of Transportation. In time of war, it becomes a service in the Navy, but continues to perform its normal, specialized duties.

The Coast Guard is responsible for a large part of all federal operations connected with

peacetime maritime activities. In time of war, these peacetime activities take on added importance because of the need for fast and dependable movement of military personnel and supplies. The Coast Guard helps other Government agencies in special missions for which its personnel and equipment are well suited.

The Coast Guard can operate immediately and effectively as a service of Navy in time of war. In order to make such a transition with a minimum of trouble, the Coast Guard's peacetime organization, regulations, training, and customs parallel those of the Navy. Personnel receive the same pay and allowances as the corresponding grades and rates in the Navy, uniforms are similar.

Whenever the Coast Guard operates as a service in the Navy, its personnel are subject to the laws prescribed for governing the Navy, and precedence between commissioned officers of corresponding grades of the two services is determined by date of rank.

Coast Guard officers and enlisted personnel are eligible to attend the various schools maintained by the Navy, Army, and Air Force.

Transfer of military stores, supplies, and equipment of every type is authorized between the Navy, Army, and Coast Guard. The Secretary of the Navy is authorized to build vessels for the Coast Guard at naval shipyards.

In 1967, the Coast Guard was removed from the Treasury Department (to which it had been assigned since 1790) and placed in the newly-created Department of Transportation When operating in the Department of Transportation, the Commandant of the Coast Guard reports to the Secretary of Transportation When operating in the Navy Department, the Commandant reports to the Secretary of the Navy and the Chief of Naval Operations

FUNCTIONS OF THE COAST GUARD

Law Enforcement

The Coast Guard is the Nation's main maritime safety and law enforcement agency in time of peace Its primary function is the enforcement of all Federal laws upon the high seas and in waters that are subject to the United States. This includes the administration of laws and the enforcement of regulations for the safety of life and property. Among the more important duties in this field are enforcement of the navigation and inspection laws, anchorage regulations, and laws relating to internal revenue, customs, immigration, neutrality, and conservation and protection of fisheries and wildlife which require marine or aviation personnel and facilities for effective enforcement.

Port Security

One of the Coast Guard's major duties in the national defense program is port security—safeguarding against destruction or loss from sabotage. This duty includes the prevention of illegal entry from the sea of persons or things, supervision and control of the loading of explosives and other dangerous cargoes, security checks of merchant marine officers and crewmembers, security screening of waterfront workers, and patrolling approaches to principal harbors.

Search and Rescue

The Coast Guard maintains inshore and offshore rescue surface ships, aircraft, lifeboat stations, and rescue coordination centers in each Coast Guard district It provides medical aid to crews of vessels at sea, cares for and transports shipwrecked persons, and engages in flood relief work In one recent year, the Coast Guard responded to 42,000 calls for help involving some 127,000 people

Icebreaking and Ice Patrol

The Coast Guard removes or destroys derelicts, wrecks, and other dangers to navigation. With its icebreaking facilities, it assists marine commerce by opening ice-blocked channels and ports It conducts the International Ice Patrol in the North Atlantic to protect shipping from the danger of icebergs, and carries out oceanographic studies

Ocean Stations

The Coast Guard operates ocean stations in the North Atlantic and North Pacific. The function of an ocean station is to provide meteorological services in ocean areas regularly traveled by ships and aircraft, search and rescue, communication, and air navigation facilities.

Merchant Marine Safety

Functions of the Coast Guard that relate to the merchant marine include the following: investigation of marine disasters and collection of statistics relating to such disasters; approval of plans for construction, repair, and alteration of vessels; issue of certificates of inspection and permits indicating approval of ships for operations that may be dangerous to life and property, regulation of the transportation of explosives and other dangerous articles on vessels; licensing and certificating of officers, pilots, and seamen, enforcement of manning requirements for the mustering and drilling of crews, suspension of licenses and certificates, licensing of motorboat operators, shipment, discharge, protection, and welfare of merchant seamen, and the enforcement of rules for lights, signals, speed, steering, sailing, passing, anchorage, movement, and towlines of vessels

Aids to Navigation

The Coast Guard establishes and maintains marine aids to navigation such as lights, radio beacons, radio direction-finder stations, buoys, and unlighted beacons It maintains the United States system of loran (long range aid to navigation) to serve the needs of the Armed Forces, mariners, and maritime airborne commerce.

The Coast Guard maintains about 40,000 aids to navigation in the United States and overseas These aids include some 60 loran stations, 350 manned light stations, and 30 lightships or offshore light structures.

Coast Guard Training

The United States Coast Guard Academy at New London, Connecticut, exists to provide career officers for the United States Coast Guard. Among the five Federal Service Academies, it is the only one that makes appointments solely on the basis of an annual nationwide competition. The graduate must serve a minimum of five years as a Coast Guard Officer.

The 4-year Academy curriculum offers nine majors which include· electrical, civil, ocean, and marine engineering, marine science, mathematical sciences; physical science; management, and government. With the Engineer's Council for Professional Development Accreditation in three of the engineering majors, the Academy is particularly attractive to engineering students. Graduates of the Academy are awarded a Bachelor of Science degree and are commissioned as Ensigns in the United States Coast Guard.

After the initial tour of sea duty, Coast Guard officers are encouraged to apply for post-graduate education or specialized training in the field· of their choice. The particular graduate specialties available for choice are dictated by the needs of the Coast Guard. Over sixty percent of the graduates pursue further education in leading civilian and military graduate or professional schools in such fields as law, engineering, electronics, business administration, oceanography, naval architecture and aviation.

UNITED STATES MERCHANT MARINE

A nation's merchant ships are an important part of her seapower They are far more than a means of transportation. They make the entire world a market for our products. They bring back to our ports the materials that we lack and that are essential to our industries. Their visits to remote ports present American ideas and ideals to foreign nations.

MERCHANT MARINE TRAINING

The program for training personnel for service in the Merchant marine was established

in 1938 by the U.S. Maritime Commission. Training stations and training ships were established on the Atlantic, Gulf, and Pacific coasts. In postwar years, merchant marine training became a duty of the Maritime Administration, under which a peacetime training program now exists through the U.S. Merchant Marine Academy and state maritime academies.

The Merchant Marine Academy trains American citizens to become officers in the merchant marine. The course takes 4 years. The first year is at the Academy, located at King's Point, New York. The second year is aboard merchant ships. The last 2 years are at the Academy. Graduates receive a merchant marine license as third mate or third assistant engineer. They are eligible to apply for a commission as ensign in the Naval Reserve. The Academy grants a bachelor of science degree.

In addition to the academy at King's Point, the Maritime Administration supervises five merchant marine schools in Maine, New York, Massachusetts, California, and Texas. These state institutions operate with the aid of Federal funds. Upon graduation, students receive a license similar to those awarded to King's Point graduates. Upon application and acceptance, they are commissioned as ensign in the Naval Reserve.

PEACETIME ORGANIZATION

The Merchant Marine Act of 1936, in its Declaration of Policy, states.

> "It is necessary for the national defense and development of its foreign and domestic commerce that the United States shall have a merchant marine (a) sufficient to its domestic waterborne commerce and a substantial portion of the waterborne export and import foreign commerce of the United States and to provide shipping service on all routes essential for maintaining the flow of such domestic and foreign waterborne commerce at all times, (b) capable of serving as a naval and military auxiliary in time of war or national emergency, (c) owned and operated under the United States flag by citizens of the United States insofar as may be practicable, and (d) composed of the best-equipped, safest, and most suitable types of vessels, constructed in the United States and manned with a trained and efficient citizen personnel. It is hereby declared to be the policy of the United States to foster the development and encourage the maintenance of such a merchant marine."

The United States Maritime Commission, which came into being under the act of 1936, was created for the purpose of carrying out this policy.

Since 1961, responsibility for Federal programs concerned with the promotion and development of the merchant marine has been given to the Federal Maritime Commission and the Maritime Administration in the Department of Commerce.

The Federal Maritime Commission exercises regulatory control over rates and practice of ocean shipping lines. It also reviews agreements among ship operators and freight forwarders for evidence of unfair practices.

Located within the Maritime Administration, the Maritime Subsidy Board makes determinations regarding ship construction and operating subsidies.

The Maritime Administration carries out the administration of subsidies and directs programs of shipbuilding, ship operation, and reserve fleet maintenance. Through the National Shipping Authority established in March 1951, it operates vessels through general agents appointed from private shipping companies. These vessels supply services such as the carrying of military goods when privately owned or chartered vessel are not available at reasonable rates.

THE NAVAL RESERVE

It is very expensive for the Nation to maintain a large military force at all times. Therefore, Federal law establishes a reserve component that will provide trained unit and individuals. These will meet the mobilization needs of the service unitl the time when

stepped-up supply and training programs can fulfill all further mobilization requirements.

The mission of the Naval Reserve is to maintain trained reserve units and personnel for employment in the active forces as may be directed by the Chief of Naval Operations.

The Navy's early mobilization requirements are many. Additional ships and aircraft must be added to the active fleet immediately. Peace-time personnel strength must be increased to wartime complement. Fleet support and shorebased activities must be enlarged. Newly procured officers and enlisted personnel must be trained.

CHIEF OF NAVAL RESERVE

The Chief of Naval Reserve commands the Naval Reserve forces through regional Readiness Commands. The manning and administration of the Reserve forces is coordinated to meet the mobilization requirements of the Fleets and the major shore activities.

MARINE CORPS ORGANIZATION AND EQUIPMENT

The Marine Corps stands ready to carry out many different missions. First among them is preparation for assault amphibious operations. Other missions include service afloat, security of naval installations and diplomatic missions, airborne operations, training of foreign military forces, and support of other services. The legal authority for Marine Corps missions is the National Security Act of 1947, codified in Title 10, United States Code.

Figure A-3 shows the general organization of the Marine Corps.

FLEET MARINE FORCE

The Fleet Marine Force (FMF) has been in existence since 1933. It is the main fighting strength of Marines assigned to the Operating Forces. The FMF includes all air and ground tactical units of the Marine Corps. It is organized into two type commands, designated Fleet Marine Force Atlantic and Fleet Marine Force Pacific.

The type commands are organized into air-ground task forces combining all air and ground arms in powerful, fully mobile striking forces. These forces may be built around units as small as regiments and air groups, or may be large enough to include several divisions and air wings.

The primary mission of the Fleet Marine Force is to conduct oversea amphibious operations. They provide for the seizure and defense of advanced bases as part of a naval campaign. The nature of this mission requires that it be kept in a very high state of readiness for employment. All its units must be completely mobile. One Marine base on each coast is set aside as the point at which the bulk of FMF ground units for the fleet in question is concentrated. There is one Marine Corps air station, similarly located, which affords a home station on each coast for FMF air units.

Because of its completely self-supporting character, the Fleet Marine Force is a unification of all arms and branches. It can perform virtually any military mission ashore including extensive land warfare such as in Korea and Vietnam.

Marine Division

The Marine division is the basic Marine Corps ground organization capable of combat. A division consists of three infantry regiments, an artillery regiment, a headquarters battalion, and separate battalions for reconnaissance, antitank, engineer, service, shore party, motor transport, and medical support. Each infantry regiment consists of three infantry battalions. A battalion is the basic tactical unit of the division. It contains four rifle companies and a headquarters/service company. Companies are further divided into weapons platoons/squads/teams.

Marine Air Wing

The Marine air wing (MAW) consists of two or more aircraft groups plus headquarters and service units. Each group is made up of two or more tactical squadrons (the basic aviation unit) in addition to a headquarters and service squadron. A wing normally includes three

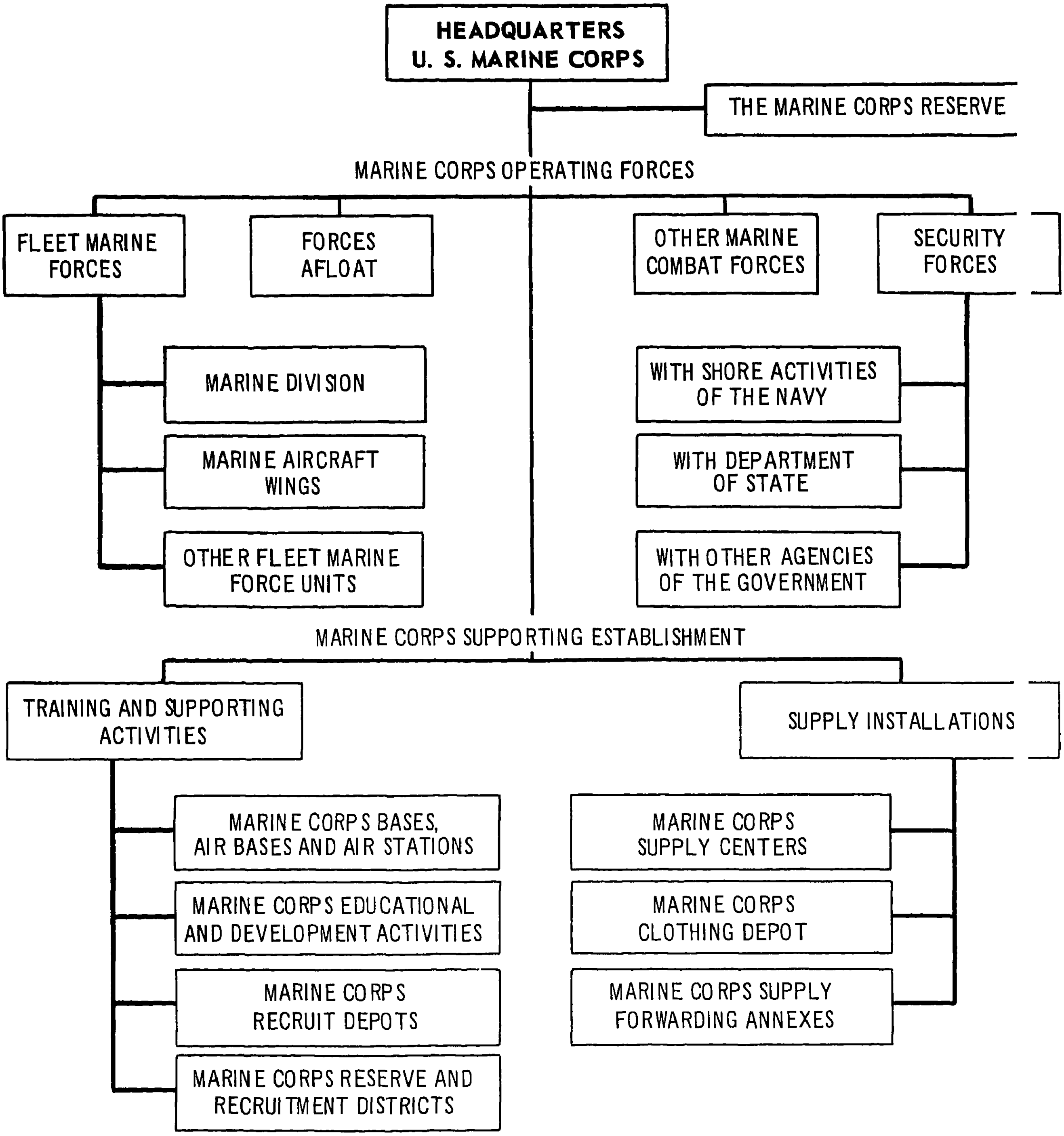

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Figure A-3.—General organization of the U.S. Marine Corps. The illustration does not delineate specific com and structure.

groups, each of which contains four squadrons. A variety of fighter, attack, reconnaissance, transport, rotary wing, and light anti-air missiles may be found in each wing. Depending on the model of aircraft assigned, a squadron will have from 12 to 20 aircraft.

Force Troops

Force troops, maintained by each FMF, are a reservoir of additional manpower available for support of a division or air wing. Force troops include service regiments for prolonged logistics support, field artillery groups for tactical fire support, tank battalions, amphibian tractor battalions, and others.

MARINE CORPS RESERVE

The 4th Marine Division/Wing team of the Organized Marine Corps Reserve is ready to increase the combat strength of the Marine Corps by one-third in a matter of weeks. This force is organized, equipped, and trained in the same manner as the regular Fleet Marine Forces. Also, there are companies in the Organized Reserve that provide personnel and force troop units

The Commandant has stated that he plans to call the Marine Corps Reserve only when regular forces are committed. The Reserve must therefore be ready to respond in a matter of weeks. The training program reflects this Reserve responsibility by providing combat-realistic air-ground training one weekend a month. Also, for two weeks each summer, Reserve and regular units train together and frequently join forces in exercises which prepare them for roles in combat.

WOMEN MARINES

During World War I, 305 women reservists, called "Marinettes", served in clerical jobs in order to free male Marines to fight in France. In February 1943, the Marine Corps again called for women to release men for combat. By June 1944, the authorized quota of 18,000 enlisted had been met and approximately 800 officers trained and assigned.

Unlike World War I Women Marines, the World War II women reservists performed over 200 different military assignments. By July 1946, all women Reserves became eligible for discharge. They had performed well in answering the Corps' call to "Free a man to fight."

By Act of Congress on 12 June 1948, authority was given to enlist women in the regular Marine Corps. Soon a woman's officer training detachment was set up at Quantico. The Third Recruit Training Battalion was activated at Parris Island for the training of enlisted women.

Today women Marines serve in almost all the non-combat fields. They are found most often in personnel administration, informational services, automatic data processing, Marine Corps exchange, aviation, supply, and disbursing. They are an integral part of the regular Marine Corps team. They provide a nucleus which could be expanded rapidly in the event of mobilization.

MARINE CORPS EQUIPMENT

Heavy equipment of the Corps includes tanks, anti-tank vehicles, amphibians, artillery pieces, missiles, and aircraft.

Tanks

There are three armored, fully tracked, combat tanks available to the Corps: medium gun, heavy gun, and flamethrower.

The medium gun tank mounts a 90-mm (1 inch equals 25.50 milimeters) gun and 30-caliber machinegun plus a 50-caliber machinegun. It weighs 52 tons, can travel 30 mph, climb 60-percent grades, scale 3-foot-high obstacles, ford 8-foot-deep streams (this capability is provided by a special kit), and cross 8 1/2-foot ditches. The crew numbers four.

The heavy gun tank is equipped with weapons similar to the medium tank, except that a 120-mm gun replaces the 90-mm gun. Weight is 66 tons, top speed is 23 mph. Fording, climbing, and crossing capabilities are the same as the medium tank. It has a crew of five men.

The flamethrower tank is similar to the medium gun tank except that the barrel contains

the nozzle of a flamethrower than can attain a range of 250 meters (1 meter equals 3.28 feet) for about 1 minute.

Anti-Tank Vehicle

The Marine Corps tank destroyer, shown in company with the flamethrower tank in figure A-4, is called Ontos. This is the Greek word for "thing." Ontos mounts six 106-mm recoilless rifles, four 50-caliber spotting rifles, and one 30-caliber machinegun. The vehicle weighs about 10 tons and is capable of speeds up to 30 mph. It carries a crew of three. Lightly armored, it is more vulnerable to shellfire than the tan' ; it opposes. Being smaller, it is less able to ‹ oss natural obstacles. Its low silhouette and s ıall dimensions provide ambush capability.

Amphibian Vehicles

At present, the only amphibians autho zed for use by the Corps are LVT (landing vel cle, tracked) types. The basic vehicle is the I 'TP (landing vehicle, tracked, personnel) design 1 to land combat troops and their equipment ı an amphibious assault. Maximum load of the I 'TP (fig. A-5) is 34 troops or 6 tons of cargo (9 ons

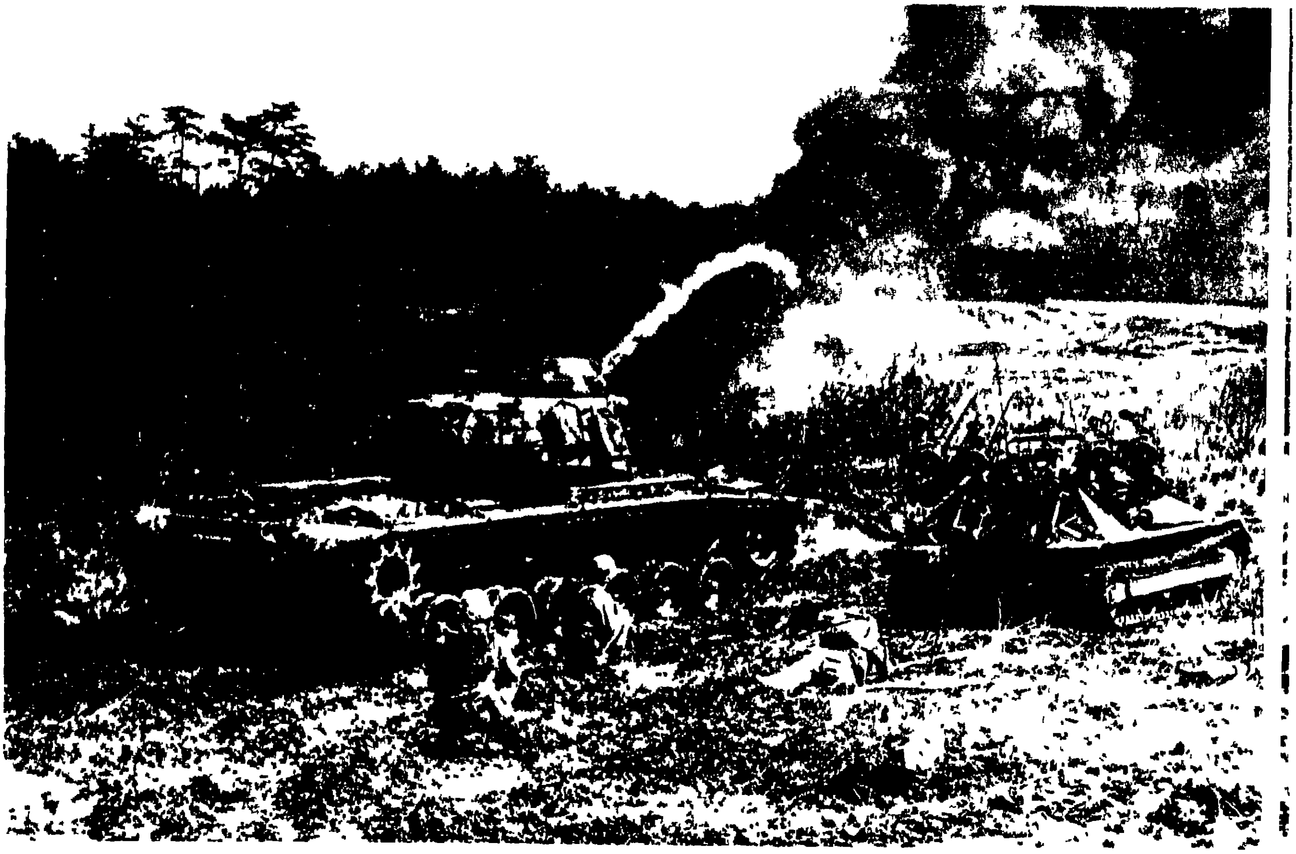

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Figure A-4 —The flamethrower can incinerate targets 250 meters away. Compare the tank's size with that of th Ontos tank destroyer alongside. Notice the accompanying infantry, without which armored vehicles would be at the mercy of enemy troops armed with grenades and rocket launchers.

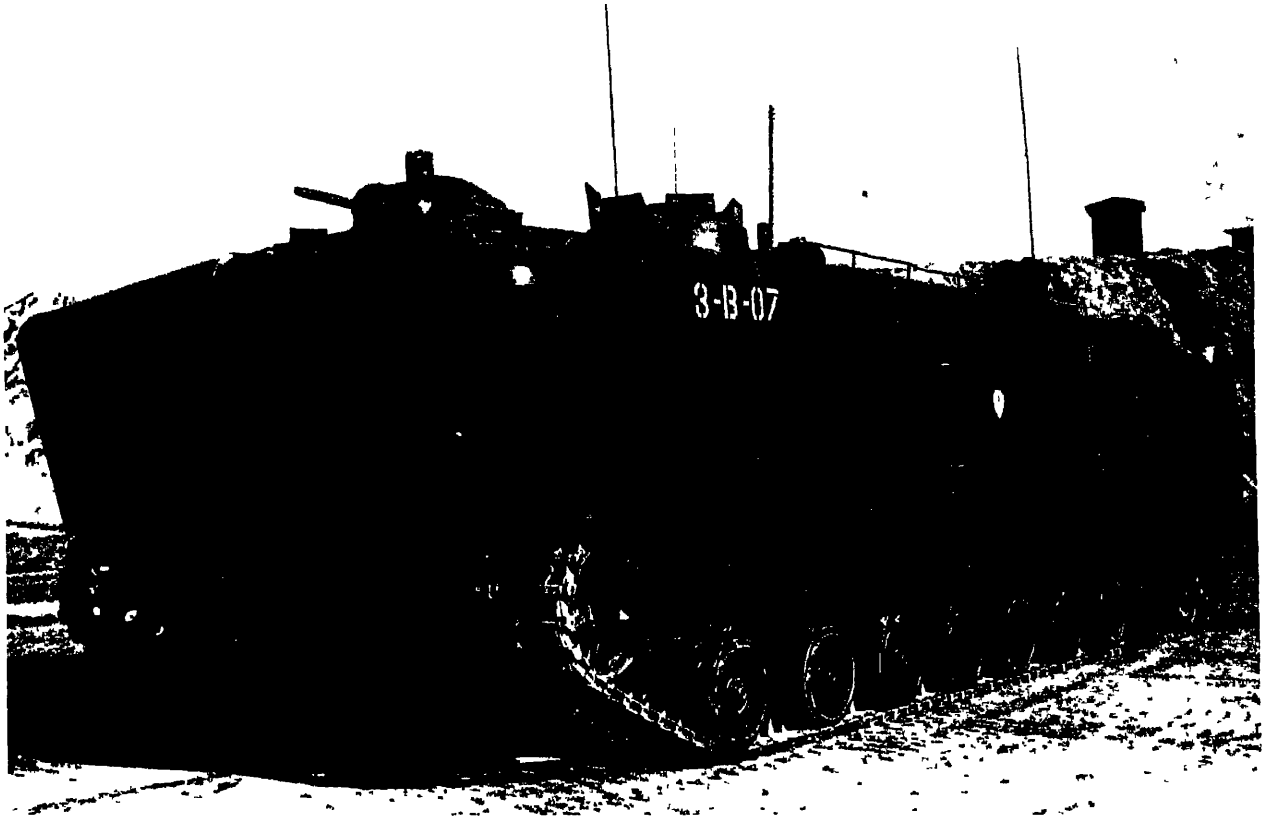

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Figure A-5.—All Marine Corps amphibians are LVTPs, many of which are modified to perform various missions other than ferrying personnel to the beach during an amphibious assault.

on land). Waterborne speed is 6 knots. Ashore it can travel 30 mph, climb 70-percent grades, surmount 3-foot-high vertical obstacles, and cross 12-foot-wide ditches.

Other versions of the basic LVT include LVTE (engineer), designed for minefield clearance and obstacle breaching, LVTC (command), which has necessary electronic equipment installed to provide command and control during ship-to-shore and subsequent operations, LVTH (howitzer), for fire support of initial assault forces, and LVTR (recovery mission), which provides mobile repair facilities for disabled vehicles.

Standard armament of the LVTs consists of a single 30-caliber machinegun. The LVTH also mounts a 105-mm howitzer and a 50-caliber machinegun. Crews number from three to eight, depending on vehicle use.

Artillery

Artillery pieces of the Corps consist of howtars (combination of howitzer and mortar), towed and self-propelled howitzers, and self-propelled guns.

The howtar is a combination 107-mm (4 2-inch) mortar and conventional artillery wheeled carriage. Range is about 6300 meters.

The standard artillery piece is the 105-mm towed howitzer. Mounted on a wheeled carriage,

it fires a 33-pound high-explosive (HE) shell to an effective range of 11,400 meters. It also can fire white phosphorus, illumination, smoke, and "bee-hive" rounds (a bee-hive is composed of tiny plastic darts used for repelling humanwave attacks).

Mounted on a tank-like body propelled by tracks, the 155-mm self-propelled howitzer fires a 97-pound HE shell to an effective range of 14,000 meters. This model is being phased out of service.

The 155-mm self-propelled gun fires the same shell as the 155-mm howitzer to an effective range of 18,000 meters.

The 8-inch self-propelled howitzer is the Corps' most accurate artillery piece. It fires a 200-pound HE round to an effective range of about 16,000 meters. Classed as heavy artillery this weapon is not included in artiller regimental organization. It is deployed by forc troops as required.

Currently under consideration by the Corp is the 175-mm self-propelled gun. An Arm battalion attached to the Marines employed th weapon along the Demilitarized Zone to she positions in North Vietnam.

Missiles

In addition to conventional weapoı , Marines utilize surface-to-air missiles to defe ground forces from low-level air attack. Figı e A-6 shows mobile-launched Hawk missi s defending a hill near DaNang, Republic f Vietnam. New missile developments inclu e

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Figure A-6.—In addition to conventional weapons, Marines utilize surface-to-air missiles for ground defense.

one-man operated antitank and antiaircraft missiles.

Aircraft

Marine aricraft units include attack (VMA), all-weather attack (VMA(AW)), fighter (VMF), fighter/attack (VMFA), composite reconnaissance (VMCJ), transport (VMR), observation (VMO), and aerial refueler transport (VMGR) squadrons, and helicopters.

NATIONAL SECURITY

Most nations, even in peacetime, maintain espionage organizations for the purpose of getting information about other countries. The activities of these organizations have always been a great danger to security.

Espionage no longer involves a relatively few isolated spies trying to obtain military or naval information from high-ranking officers. It is a large effort by thousands of unimportant people in minor positions. They depend on the slow accumulation of bits of information until it tells a story. A single hint may prove to be an important piece in the jigsaw puzzle the enemy is putting together.

The agents of enemy espionage are in favor of enemy aims, even though in some cases they have been forced into service by threats. During a war, their job is to obtain as much valuable information as possible and to assist the enemy by spreading false reports, committing sabotage, directing invading forces, crippling key industries and utilities, seizing communication centers, and generally cracking defense and undermining morale. To say that they are a serious threat to a nation's security is telling it like it is.

DATA DESIRED BY THE ENEMY

What are some of the things that a possible enemy expects his agents to obtain? Obviously, information about convoys, nuclear weapons, and supersonic aircraft should not be disclosed. Most people grasp the importance of such data to an enemy. But what many do not realize is that the enemy is interested in data which appears to be general and harmless information. Some understanding of the enemy's interest may be gained from the following questions (taken from official files), the answers to which enemy agents operating in this country during World War II were told to obtain.

What is the situation with respect to manufacture of steel plates covered with rubber manufactured by the U. S. Rubber Company? How many sheets of steel and how many sheets of rubber do the plates contain? What is the total thickness of the plates? Is the exterior sheet rubber or is it steel?

What is the daily production of munitions by the Bethlehem Steel Corporation?

What food supplies, raw material, and machines are being sent to England?

What manufacturing plants have branches in Canada, Australia, and New Zealand?

How many American pilots are being turned out monthly?

What products does the Sperry-Rand Corporation manufacture in its new plant at Salt Lake City, Utah?

The answers to all of these questions could be brought out in the course of a friendly conversation. The following incident which occurred during World War II demonstrates how easy it is for unthinking persons to reveal important information.

A public utility company of an eastern state, in order to gain public goodwill by advertising its war effort, wanted to release some advertising in which was recorded the fact that the company had done much work in connection with the plant expansion of a certain aircraft factory. It was pointed out that a new electric substation had been constructed at a certain point, in order to give the company additional electrical facilities. No imagination is required to appreciate the usefulness of this bit of information to an enemy saboteur. In this particular instance the firm left out the information when its importance was brought to its attention by the Navy Department.

Here is another set of questions that an enemy agent was trying to answer during World War II. What new war material factories are

being constructed? Where are these plants located? When will they begin to make deliveries?

An example of this kind of thing is the story of a United Press war release by a writer who had escaped from occupied territory. In his article, the writer recalls an incident that took place on a train on which he was a passenger.

"Coming into Detroit from the West" he wrote, "a group of us who were chatting were startled when one passenger called out, 'Look! There's that big new bomber plant!' A state highway running near this gigantic midwestern bomber plant had been blocked and detoured. But the helpful passenger made sure that all of us got the only close-up—from the train, which runs closer to the plant than any public road."

The locations of large amount of military supplies are always of interest to enemy agents. The following quote shows how thoughtless talk might give an enemy agent the information that he has been assigned to gather

> "Riding from Cincinnati to Cleveland, I was reading a book when the porter said to me, 'Look at those flat-cars loaded with Army stuff!' By looking quickly between the box-cars on the siding we were passing, I could see a long row of Army machinery standing on flat-cars on a more distant siding. A German saboteur probably would have missed them because of the box-cars if he didn't have a helpful porter."

The Navy is a possible source of valuable information. Attempts to use that source are to be expected. The methods that may be used are many—placing agents within the naval establishment, taking pictures or stealing documents, bugging telephones and telegraph lines, attacking codes, analyzing naval radio personnel when off duty. Although bits of information obtained this way often appear harmless, they prove to be of real value when studied and combined with information from other sources. The need for preventive measures on the part of all naval personnel is very important.

Security is a means—not an end. Rules that govern security of information are like gunnery safety orders. They do not guarantee protection, and they do not attempt to meet every possible situation. The law of diminishing returns limits the control measures that can be used, but it is possible to obtain a good degree of secrecy with a minimum of sacrifices.

Security of information is obtained by many practices, precautions, and safeguards which include adequate measures against the following:

1. Capture or salvage of classified matter.
2. Theft, espionage, observation, and photography.
3. Interception of communication traffic.
4. Radio direction finding or tracking.
5. Traffic analysis.
6. Cryptanalysis.
7. Fake messages and other false communications.
8. Carelessness and laxity of personnel.

PROOF OF ENEMY SUCCESS

The following cases have been taken from official records of World War II. In many cases it is impossible to say just how the enemy got his information, but there is no doubt that much of it was gained from persons who had no intention of helping the enemy.

Case 1. A submarine attacking one of our convoys focused its torpedoes on two ships in the center. These ships had been assigned their central position in order that they might be afforded the best maximum protection. The enemy knew that these two vessels were carrying cargoes of special military supplies.

Case 2. Documents captured on Saipan showed that the enemy in the Pacific had put together very complete information about the strength of both Army and Navy air forces. The scope of this information showed that it had been painstakingly assembled from many different sources.

Case 3. The captain of a fast cargo ship in the Pacific had thought it safe to cable his sailing date in code to this country. The date was not

kept secret. The ship was torpedoed and the captain was lost, probably not knowing that is was because of his own carelessness.

While the cases just described cover wartime situations, the principles apply during peacetime as well. There may be relaxation of overall security for economic reasons, reduction in personnel, and for general peacetime well being. It is important that all current security laws be applied even in peacetime.

Possible enemies are always gathering information through their systems of espionage. Alertness to this situation is always necessary.

SECURITY CONTROL AND RESPONSIBILITY

The Chief of Naval Operations controls all policies relating to the security of classified matter. The Commander, Naval Intelligence Command is the officer responsible to CNO for making policies that relate to security of classified matter. The CNO has given to the Commander, Naval Security Group Command the authority for running the Navy communications security program.

Instructions are necessary for the proper administration of the security system. These are issued by the Chief of Naval Operations. Current instructions are in the *Department of the Navy Security Manual for Classified Information* (usually referred to as the *Security Manual*), and the *Registered Publications Manual.*

CLASSIFICATION CATEGORIES

Official material that needs protection in the interests of national defense is limited to three kinds of classification. In descending order of importance, these are Top Secret, Secret, or Confidential. No other designation is used to classify defense matter, except as provided by law (e.g., Restricted Data and cryptographic systems). The test for the classification is the content of the subject matter. The words matter, material, and information, all mean the same thing.

Officers in command are responsible for the classification of matter written within their commands. The "maker" or "drafter" of a new machine, a new device, a message, a letter, a report, or a document of any kind is responsible to his commanding officer for making it Top Secret, Secret, or Confidential if it falls within one of the definitions (explained below). He should avoid the tendency toward overclassification. Through the steps of preparing the material, typing or printing, and distribution, the same degree of security is necessary that will be given the finished product. Destruction of carbon paper and rough scraps is very necessary.

TOP SECRET

The classification Top Secret is used for defense information or material that requires the highest degree of protection. The Top Secret classification is applied only to that information for which unauthorized exposure could result in exceptionally grave damage to the Nation, such as–

1. Leading to a definite break in diplomatic relations affecting the defense of the United States, an armed attack against the United States or its Allies, a war
2. The release of military or defense plans, or intelligence operations, or scientific developments vital to the national defense.

SECRET

Material classified as Secret is limited to defense information or material for which the unauthorized exposure could result in serious damage to the Nation, such as–

1. Endangering international relations of the United States.
2. Endangering the effectiveness of a program or policy of vital importance to national defense.
3. Compromising important military or defense plans, or scientific developments important to national defense.
4. Revealing important intelligence operations.

5. Nonapproved wire circuits.
6. Visual means.
7. Sound systems.
8. Radio.

The only possible way to obtain absolute transmission security is to stop sending messages. This applies particularly to radio, and that is sometimes impossible. Messages have to be sent and communications established to conduct any type of operation.

Use of one of the more secure transmission methods mentioned above tends to reduce the amount of traffic available to an interceptor.

An officer messenger is the most secure means of delivering a document. When a messenger is carrying classified material, he carries it on his person at all times. He is armed, and the safety of the material is his greatest responsibility.

At sea, sending messages by dispatch boat or visual means is better than radio. Boat service is the most reliable of these and can often be carried out with speed. Visual methods are more secure than radio and ease the load which is usually placed on radio.

Wire systems include telephone, telegraph, teletypewriter, and facsimile. They are grouped into two categories approved and nonapproved circuits. Approved circuits are designated by appropriate command The classification of messages that may be sent in the clear over an approved circuit depends on the classification rating of the circuit. Electrical circuits are not approved for sending in the clear (uncoded) of any traffic having a classification higher than Secret. Circuits not approved by appropriate command are termed nonapproved circuits

Classified information is not transmitted in the clear over nonapproved circuits except when a message is too urgent to wait for encryption, and when the speed of delivery is more important than the value of the information to the enemy. Wire communications offer greater security than radio and should be used in preference to radio whenever possible.

Radio is the most used, the most overloaded, and the least secure means of all Each message sent by radio is open to reception by any friend or enemy who has the necessary equipment. There is no other way when at sea unless the message can wait; but in port or at shore stations, transmission by mail if often good enough.

RESEARCH AND DEVELOPMENT

The research and development effort in the Department of Defense is big business. It is large in terms of men, money, and materials. The scientific and military strength of the United States depends heavily on the success of a research program.

All of the Navy's systems commands have research and development programs. They are given research, development, test, and evaluation (RDT&E) funds. These funds are passed on to their field activities, other Government agencies, private industry, universities, and naval laboratories.

Our R&D program involves scientific areas and uses technology in every field. Development programs include just about every type of equipment and weapon in the national arsenal.

At the top of the Navy RDT&E organization, is the Secretary of the Navy. The Assistant Secretary of the Navy for Research and Development (ASN(R&D)) is responsible to SecNav for control of Navy RDT&E matters. The principal advisor to SecNav and to the ASN(R&D) for research matters is the Chief of Naval Research. The Chief of Naval Development advises in matters relating to the development of research.

The Office of Naval Research conducts research itself and helps with the R&D efforts of the Navy's systems commands and bureaus The Chief of Naval Research coordinates the entire research program of the Navy.

The Naval Research Advisory Committee provides policy guidance to SecNav This committee is composed of qualified scientists and engineers, the Director of Defense Research and Engineering, and the Joint Chiefs of Staff. The advice of the committee is submitted to ASN(R&D) who issues policies and guidance for the research and development program

Under the Chief of Naval Operations, there is a Long Range Objectives Group. It prepares Navy operational objectives for 15 years into the

future. The objectives are based on the possible threat in the future. It includes trends in national policy, and the predicted state of the technical arts. These objectives are updated each year. While they are concerned mostly with strategy, tactics, and the make up of the fleet in the future, they are spelled out in terms of research and development.

The Chief of Naval Operations also writes requirements for systems and hardware based on the requirements of the Operating Forces. These requirements are sent to the "warfare desks" under the Deputy Chief of Naval Operations for Development. The warfare desks then generate requirements of the fleet for new hardware and weapons. The DCNO (Development) is responsible for the requirements for new equipment and weapons which come from the warfare desks. He organizes the overall Department of the Navy operational research, development, test, and evaluation program. The effort must consider long range objectives, operational requirements, money limitations, and advancing technology. The DCNO (Development) also advises the Assistant Secretary of the Navy for Research and Development concerning the development, test, and evaluation program of the Navy.

These operational requirements are used by DCNO (Development) to influence the efforts of the systems commands, bureaus, and offices. There is no direct line of authority from CNO to the technical and procurement commands except through the Chief of Naval Material.

Several agencies develop and acquire the equipment and weapons required by CNO for Navy Operating Forces They are the Naval Material Command, the Office of Naval Research, and the Marine Corps. The systems commands under the Chief of Naval Material perform two jobs. They manage and conduct research and development, and they produce hardware and weapons required by the Operating Forces. They may act as contracting agents for the Navy if the research, development, or production is performed by industry or private institutions They may act as management agents if the work is done by the Navy itself. Overall Navy coordination and review of the RDT&E program goes through ASN(R&D). Ultimate responsibility rests with the Secretary of the Navy.

EARLY NAVY RESEARCH

About the middle of the 19th century, the Navy established its first testing laboratories to keep pace with civilian inventions and the general growth of technology. Commander Charles Henry Davis, Superintendent Alexander Bache of the Coast Survey, and Dr. Joseph Henry of the Smithsonian Institution were members of the "Permanent Commission" set up by Secretary of the Navy Gideon Welles to advise the department on scientific matters. The success of this commission led, in 1863, to the National Academy of Sciences. It was to provide scientific services to all departments of the Government.

One of the Navy's first steps to organize scientific effort was a device for testing lubricating oils at the New York Navy Yard in 1866. The establishment in 1869 of a naval torpedo station at Newport, RI was used to test torpedos and their equipment, explosives, and electrical devices The opening of an experimental model basin at the Washington Navy Yard in 1900 was a later development. The Naval Ship Research and Development Center, formerly called the David Taylor Model Basin, is now the world's finest research laboratory for the development of hull forms. It provides for the gathering of information about the behavior of ships in water. Today it is the center of technical and scientific areas of interest to the Navy.

Individual naval officers, with or without formal training in science, appreciated the fact that science might make contributions to the solution of naval problems. Lieutenant M. F. Maury, USN, as Superintendent of the Depot of Charts and Instruments (established in 1830), caused research in astronomy, geology, mineralogy, and oceanography. Rear Admiral John A. Dahlgren often referred to as the father of modern gunner, built the Navy's first big guns. He advocated the development of effective gun sights, and insisted that naval guns be rifled. In the early 1890s Lieutenant William S. Sims made a thorough study of European gunnery

practices. He was very successful in applying the scientific method to the development of gunnery training and fire control. Lieutenant Bradley A. Fiske introduced the rangefinder, telescopic sights, and director fire into the United States Navy practice. He also believed in development of the torpedo plane.

RESEARCH IN WORLD WAR I

Before the U.S. entered World War I, the Navy Department became aware of the rapid changes being made in naval warfare. The Navy took steps to put into effect a program of naval research and development. In 1915 Secretary of the Navy Josephus Daniels created the Naval Consulting Board, known as the Inventions Board, as a means of using the nation's technical skills. Thomas A. Edison was the chairman. It was made up of groups and scientific societies of the country. In addition to serving the Navy, this Board organized the nation's Industrial Preparedness Campaign.

The National Academy of Sciences also set up the National Research Council. Here the resources of different groups of scientists would be brought to bear in the solution of the major scientific and technical problems of the War and Navy Departments. In this way, research of the greatest importance was undertaken in such fields as submarine detection, gun ranging, and naval camouflage.

Both the Naval Consulting Board and the National Research Council helped in the development of antisubmarine warfare devices. This was important to oppose Germanys' submarine campaign.

The Consulting Board designed a nonricocheting shell which would destroy a submarine even if partly submerged. Another device produced by the same organization was the hydrophone. This device would detect the noise of a submarine's propellers at some distance, the sound waves being transmitted by the water. This equipment made it possible to determine the direction and the distance of the boat spotted. The hydrophone played an important part in winning the first Battle of the Atlantic.

In its race to defeat the Kaiser's submarines, the Navy also developed the "antenna mine." It was used so well in the great North Sea mine barrage to restrict U-boat operations. The Navy took steps to protect both merchant ships and its own vessels against submarine attack by developing "razzle-dazzle" camouflage. Camouflage contributed to the difficulty of estimating target course. This decreased the accuracy of gun and torpedo fire.

RESEARCH BETWEEN WORLD WARS

As has been seen, research had been greatly stimulated during World War I, especially in naval weapons and countermeasures. Immediately after the end of that conflict the United States Navy undertook an expansion of its research facilities. The establishment of the Naval Research Laboratory in 1923 (fig A7) and the conversion of the Mine Laboratory in 1929 were early developments.

In 1915 Thomas A. Edison, as chairman of the Naval Consulting Board, urged the creation of a laboratory to be devoted entirely to naval research. Congress voted funds for this purpose the next year. It was not until 1923 that work was completed and the Naval Research Laboratory (NRL) was opened at Anacostia, DC. Its operations during the next twenty years contributed greatly to preparing the Navy for its effective participation in World War II. The laboratory provided knowledge which our scientists and technologists were able to use for development of radar, the proximity fuze, and the atomic bomb.

The Naval Ordnance Laboratory (NOL) also conducted scientific investigations during the period between the wars. Established as the Mine Laboratory in 1918, its first assignment was the development of an improved type of mine-firing device. It was later renamed the Naval Ordnance Laboratory. It now conducts an extensive program covering research and development of torpedos, mines, depth charges, mine-launching equipment, fuzes, pyrotechnics, ordnance parachutes, demolitions, guided

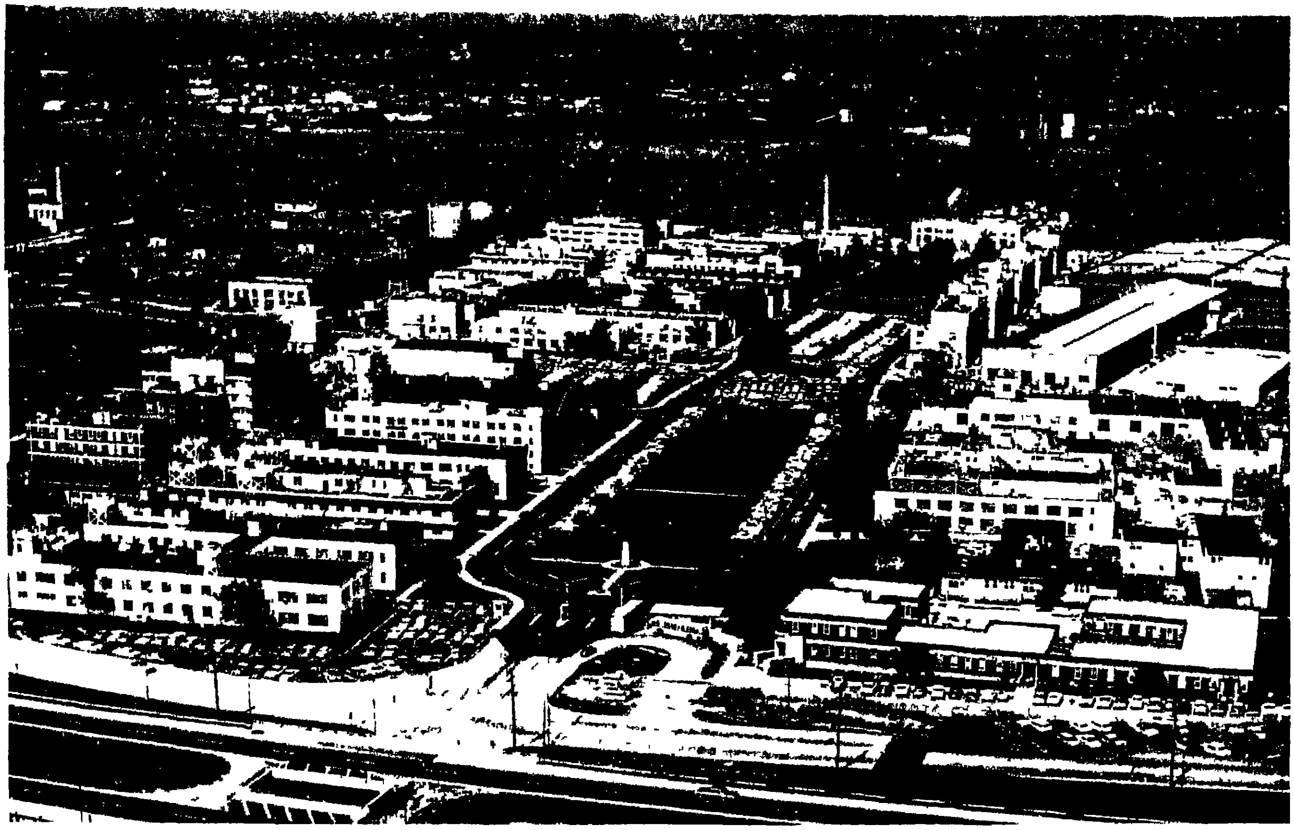

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Figure A-7.—From a modest beginning in 1923, these are the offices and laboratories of the Naval Research Laboratory as they appear today.

missiles, plastics, guns, armor, and minesweeping equipment.

With the development of the airplane, a new field of engineering and technology was opened. The David-Taylor Model Basin undertook the construction and operation of one of the first wind tunnels in the United States It was used for studying the aerodynamics of flight It soon became apparent that more facilities for aeronautical research were badly needed

The Naval Aircraft Factory was set up at the Philadelphia Navy Yard in 1917 In 1921 it began work on experimental aircraft and did important work in the field of aerodynamics. A group of American naval officers at the Naval Aircraft Factory suggested the development of guided bombs or planes years before the Germans were to make the first combat use of radio-controlled missiles.

When World War II began the Navy had already laid the foundations by scientific research for its growing strength.

RESEARCH IN WORLD WAR II

World War II marked the largest mobilization of scientists in the waging of war that the world has known. Physicists worked antisubmarine devices that helped the United States Navy to defeat the U-boat. The Mathematicians helped create the computing devices for the gun directors and airborne

torpedo directors that played an important part in the winning of final victory.

Realizing that excellence in new weapons depended on scientific knowledge, President Roosevelt established the Officer of Scientific Research and Development (OSRD) in June 1941. It was to coordinate and supplement scientific research and development work relating to the war. The nation thus set up the machinery to use its scientists in the fight against the enemy.

The Navy immediately established the Office of Coordinator of Research and Development. This office handled the necessary Navy Union with OSRD. The Navy was ready and eager to work with OSRD and was able to offer its facilities and experience in research and development programs.

Converting the products of science to warfare is a slow process. It takes years for a new weapon to go from the first idea to research, to development, to testing, to quantity production, and finally to actual use. The groundwork laid by naval research workers between the wars had saved priceless time.

Examples of the Navy's preparedness for war through science are given by D. James P. Baxter in *Scientists Against Time,* his Pulitzer prize winning account of the OSRD's activities during the war. A few quotations are presented here.

- Fire Control. The Navy "had gone a long way in developing fire control Our Navy's systems of fire control were the best in the world."

- Proximity Fuze. The development of the proximity fuze which ranks "among the most extraordinary scientific achievements of the war," Dr. Baxter states, "When the OSRD was established, the problem of proximity fuzes had already been under way for some time in the United States Navy."

- Undersea Warfare "The United States Navy started the war with well-developed echo-ranging gear .. Between the two wars the Naval Research Laboratory had made notable contributions to its development."

- Radar Countermeasures. "At the Naval Research Laboratory, where radar had been under development for years, the thought of countermeasures had also been explored. Prior to our entry into the war NRL had developed wide-band crystal receiver to pick up enemy transmissions and determine their frequency, and had under development a receiving set to cover the range from 50 to 700 megacycles."

- Atomic Bomb. "As early as 1939, the Chief of the Bureau of Engineering allotted $1500 to the Naval Research Laboratory for experiments on pilot plants for the concentration of uranium-235. This was the first, and at the time, the only Government work, on the project which grew into the atomic bomb development. Later, when the Manhattan Project coordinated all work on the bomb, a thermal diffusion plant that was needed for the partial separation of U-235 was built along lines which Baxter reveals "had been worked out by R. Gunn and P. H. Abelson at the Naval Research Laboratory and tested in pilot plants built by the Navy at Anacostia and Philadelphia.

Years of systematic research paid dividends in 1940 when Congress voted a 70-percent increase in naval construction (the Two-Ocean Navy Bill). The power of this fleet lay in the new capabilities and equipment which previous research had developed. The new fleet was fast. For example, in battleship construction, by adopting a narrow beam and light armor, more powerful engines were capable of driving the vessel at speeds up to 33 knots. The new fleet was well equipped. It could maintain itself longer at sea and cope with land-based airpower and submarines while thousands of miles from home and close to enemy bases. With radar, the new fleet could scan the ocean for ships and the skies for aircraft at all times of day or night regardless of weather. The new fleet was well protected Destroyers and destroyer escorts with their sonar gear and their greatly improved antisubmarine ordnance protected the fleet against enemy submarines. Planes of the antisubmarine patrol equipped with radar, rockets, and better depth charges increased protection of the fleet.

At Quonset Point (RI) Naval Air Station during the war, scientists were working on the magnetic anomaly detector. This was an important aid for underwater detection. They built hundreds of preproduction types of

equipment, installing them in planes and blimps, and making observational flights.

At the Naval Ordnance Test Station, hidden in the wastes of the Mojave Desert in California, the Navy's high-velocity aircraft rockets, "Tiny Tim" (11.75 inches) and "Holy Moses" (15 inches), were being tested under extremely dangerous conditions. Armitage Field at this station is a memorial to Navy Lieutenant Armitage, one of the men who lost their lives trying our new equipment before it was considered safe for the fleet.

At New London, Connecticut, and San Diego, California, scientists were studying underwater acoustics. They wanted to develop more effective aircraft, submarine, and surface craft listening equipment and other devices.

At the Naval Air Station, Floyd Bennett Field, New York, flight tests were conducted with the "Bat," the first target-seeking missile to be used in warfare.

At Alamogordo, nuclear physicists were helping Rear Admiral Parsons ready the atomic bomb for use at Hiroshima.

The naval scientists' laboratories were located in many corners of the United States. Their products reached points thousands of miles away. Their help to the fleet continued throughout the war.

Even the enemy was forced to pay tribute to the American scientist. On 14 December 1943 Germany's Admiral Doenitz wrote, "For some months past the enemy has rendered the U-boat war ineffective. He has achieved this objective, not through superior tactics or strategy, but through his superiority in the field of science."

POST-WORLD WAR II RESEARCH

At the close of World War II, the Navy faced the problem of realigning its massive research and development complex to a peacetime economy. With the lessons learned in the war clearly in mind, the Navy realized its technological future might depend on the continued use of these facilities. Naval leaders set about creating the need for scientific investigations, material development, and technological progress.

Laboratories which had been using their wartime efforts to "SOLVE" navy problems became a part of the family of naval shore activities. The Naval Electronics Laboratory, the Underwater Sound Laboratory, and the Radiological Defense Laboratory were added to the group of research and development facilities. In all, there are over forty such facilities.

To meet the needs of the Navy, these laboratories embarked on many programs of scientific and engineering interests. Research was worked on to extend the knowledge required for specific technological purposes. Efforts were made to apply the knowledge to broader development needs. This applied research, formed the bulk of the peacetime naval laboratory programs. It stressed the development of new weapons and equipment.

From 1942 onward, the Naval Medical Research Institute at Bethesda, Maryland led the way in medical research. Several other research units were established ashore and aboard. They were directed to study exotic diseases, test new supplies and equipment, and investigate medical problems involving submariners and aviators. Their findings contributed to the effective medical support of combat operations. Questions about defense against nuclear, biological, and chemical warfare were studied, as well as the psychological adjustment of servicemen to military life. The postwar bone and tissue bank at Bethesda studies the preservation of bones and various tissues valuable in surgery to save and lengthen life. By 1960, ways of preserving whole blood for later clinical use had been discovered and tested. Also, the medical problems of flight in space ships were under investigation.

Reserach and development at industrial concerns was greatly reduced at the close of World War II. The Navy continued to strengthen the efforts of its laboratories through contracts with industrial laboratories. These two programs have produced a constant flow of the latest engineering developments.

Naval leaders realized that these resources alone were not enough to assure the long-range technical advances necessary for new weapons. They cautioned that the Navy must never again leave the discovery of scientific knowledge to chance. Consequently, the Navy embarked on a

program in the basic sciences which was to become the technical foundation for the Navy's postwar research and development effort.

OFFICE OF NAVAL RESEARCH

Established as the Office of Research and Inventions and renamed in 1946, the Office of Naval Research was charged with planning and conducting research for the Navy. Its establishment was described by Secretary Forrestal as "a Navy Department insurance investment in permanent research . . . expected to provide a revolving fund for progress in research, this has made possible such spectacular developments as the atom bomb, radar, rockets, jet aircraft, and penicillin."

The main course of scientific knowledge has been the university research laboratory. The experience and lessons of World War II showed a need for a system whereby university scientists could continue their work in the solution of the Navy's most difficult problems. Because of this, ONR instituted what was, for a time, the largest peacetime research program ever supported by a Federal agency at educational institutions. Through this contract research program, ONR advanced the search for new knowledge. It studied those fields of science and engineering important to naval needs and national security. Nuclear physics, chemistry, electronics, hydrodynamics, aerodynamics, oceanography, mathematics and computing, propulsion, microbiology, phychophysiology, and the behavioral sciences were a few of the fields which were studied. Many of the nation's renowned scientists were doing research for the Navy at nearly every outstanding scientific laboratory in the country.

Today, most of ONR's funds for research are contracted out to university laboratories Research performed by these laboratories is mostly basic or pure research. Other contracts go to industrial laboratories, usually for applied research on specific projects. Any scientist or laboratory may receive a contract if its research shows promise and fits the Navy's interest. The Office of Naval Research makes other contributions to the Nation's scientific knowledge. Through its research programs thousands of graduate students obtain advanced degrees by working on important research projects.

A discussion of the Navy-wide character of ONR's research program would not be complete without mentioning the work conducted in its own laboratories. Under ONR, the Naval Research Laboratory (fig. A8), Naval Biological Laboratory, and the Arctic Research Laboratory provide numerous scientific and engineering advances. Part of the program is conducted at the request of the Navy's systems commands. A good indication of the work conducted at NRL is shown by the names of its scientific divisions: Applications Research, Electronics, Radar, Communication Sciences, Electronic Warfare, Chemistry, Metallurgy, Solid State, Space Science, Nuclear Physics, Plasma Physics, Mathematics and Information Sciences, Acoustics, Underwater Sound Reference, Ocean Science, and Ocean Technology.

LONG-RANGE RESEARCH PROGRAMS

In the area of long-range research efforts two are of current interest. They are oceanography and automatic data processing (ADP).

OCEANOGRAPHY

Oceanographic research has been going o within ONR since about 1946. The Navy ha charge of about 40 percent of the nation oceanographic institutions, universities, an technical Navy agencies. A great portion of th basic and applied research supported by ON relates closely to the programs of a number other Federal agencies.

The ocean depths are rich in natur resources. Vast amounts of minerals and oil a available. Much is heard of the "limitless" supp of seafood. The scientific and industri communities are interested in using the resources.

The study of underwater sound is not t Navy's only concern in the field f oceanography. Habitability in the deep s a

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Figure A-8.–The manipulator room of the NRL high level radiation laboratory. It is necessary to provide protective shielding for the experimenter who performs postirradiation evaluation.

environment must be studied. Future submarines are expected to operate there, and only in this way can the Navy be prepared for that day.

The ability of divers to work underwater with mechanical help is of great interest. In the summer of 1964, four aquanauts, inside a tubular structure called Sealab I, were lowered 192 feet to the ocean floor 26 miles off the coast of Bermuda Before coming back up the men lived and worked, both inside and outside Sealab I, for 11 days. The experiment was made on a larger scale in 1965 off the coast of southern California. This was designed to measure human performance in cold water (46° - 52° F) and low visibility during long-period saturation dives. Selab II employed a three-team relay system, 28 men in all, living in a 57-foot-long chamber at a depth of 205 feet for a total of 45 days.

In the "saturation dive" technique, the diver is supplied with a special gas at a pressure equal to that of the surrounding water. His body tissues become completely saturated with the gas after about 24 hours. Because pressure inside the living space and that of the surrounding water is the same, the diver can leave and return to the vehicle without any need for

decompression. Only before returning to surface pressure must he undergo slow decompression. This required a period of 31 hours in the case of Sealab II divers in order to accommodate the naturally slow escape of the high-pressure gas from his tissues. Once the diver's tissues becomes filled at a given depth, his decompression time is the same no matter how much longer he remains at the depth.

The Navy, in Tektite I, used the diving technology gained in the Sealab series for scientific purposes. Tektite I was a joint venture of the Navy, NASA, and the Department of the Interior. It was designed to determine the ability of a small group of men to conduct a scientific research mission while under isolated, hazardous, and saturated diving conditions. Four Tektite I aquanauts, marine scientists from the Department of the Interior, lived saturated at a depth of 42 feet for 60 days, in Lameshur Bay, St. John, Virgin Islands. It was the longest saturated dive by a single crew yet attempted. Possibly, by means of the saturation dive technique and new equipment being developed to help it, man will be able to remain deep under the ocean surface indefinitely. He could do more work than possible by repeated dives from the surface. Experiments to extend man's skills as a free swimmer are expected to continue until we can work as deep as 1000 feet.

Worldwide research is being conducted by means of specially equipped oceanographic research ships (AGORs). Because of the cost of operating these ships, experiments also are being made on moored information-gathering buoys. An example of such a buoy is the Navy Oceanographic and Meteorological Automatic Device (Nomad). This is a small platform made by the Naval Oceanographic Office to make oceanographic and meteorological measurements at sea.

Another form of technological development involves a new type of buoy system. It was developed by private industry for ONR to obtain oceanographic data. The objective is to produce a much-needed system for gathering and storing information and sending it to shore stations from many miles at sea. A network of these buoys scattered throughout the world's waters could give oceanographers and meteorologists information which they cannot get in any other way.

A number of Navy laboratories and universities around the country at present do research that includes investigations of the shape and nature of the sea floor. They also study descriptions of the activity and make-up of the sea itself, and the analyses of the interaction between the ocean and air related to underwater, sound, temperature, salinity, and other factors.

Many other physical properties and events such as waves, tides, currents and turbulence have technical and design implications. Practically every command and laboratory activity in Navy oceanography works in one or another aspect of this physical-properties program, which is coordinated by ONR.

The Navy's interest in ocean biology is divided into four areas. These are Bioacoustics, Biodeterioration, Noxious Marine Animals, and Marine Ecology. Basic research in bioacoustics includes the study of active sound producers (e.g., porpoises, seals, and fish) as well as sealife which affect sound broadcasting, such as the scattering layers. Biodeterioration is concerned with marine life that fouls, bores, or otherwise degrades naval structures in the ocean. Of particular interest are factors which cause creatures like barnacles and mollusks to settle on submerged structures. Noxious marine animals include hunting species, such as sharks, and poisonous sea animals. Behavioral, physiological, and distributional studies of these animals are studied. Marine ecology, the fourth area, is a broad area of interest which is related to the other three. In general, it involves a wide range of studies that increase the Navy's knowledge of its marine operating environment. The question being asked of all four areas of interest is "What impact can sea life have on naval operations, either to their benefit or harm?"

The Naval Oceanographic Office carries out a program of military surveys. Unlike the national Ocean Survey Program, which has as its objective a general strengthening of knowledge of the oceans, the military survey program is aimed specifically at the Navy's operational

needs. The surveys are either mapping and charting expeditions for important areas or they provide environmental information needed to design, install, and operate ASW systems.

PLATFORMS AND DEEP SUBMERGENCE VEHICLES

Oceanographic research has produced a number of odd-looking craft. The Flip (Floating Instrument Platform) (fig. A9), constructed for the Scripps Institute of Oceanography, and the Navy Spar (Seagoing Platform for Acoustics Research) are similar in appearance, size and operation. Each is about 355 feet long and 15 to 16 feet around. Designed to be stable floating research platforms, they are towed to their ocean stations horizontally, then floated to swing to a vertical position. The draft of each, when vertical, is about 300 feet.

The Navy uses at least two submarines as oceanographic research ships. Really deep dives below 1000 feet must be made by special diving vehicles.

There are several deep-diving vehicles (fig. A-10) and others are on the drawing boards. Probably the best known is the bathyscaph Trieste that carried Navy Lieutenant Don Walsh and the French scientist Jacques Picard into the Marinas Trench. This is the deepest known part of the ocean (35,888 feet) It later took part in the search for the ill-fated submarine Thresher which sank with all hands in the spring of 1963. An improved Trieste II, launched in January 1964, investigated the wreck of the submarine Scorpion.

The Navy is considering three types of deep-submergence vehicles. The first is designed to dive to 6000 feet and cruise at slow speeds for 8 to 10 hours.

A second type of vehicle is the deep submergence search vehicle (DSSV). It will be capable of recovering small objects and exploring the ocean floor to a depth of 20,000 feet. This includes 90 percent of the ocean floor. The DSSV is about 50 feet long, displaces 78,000 pounds, and carries a crew of four.

The third vehicle under consideration will be designed for deep trench investigations. It should be capable of operating to depths of 36,000 feet, which includes 100 percent of the ocean floor.

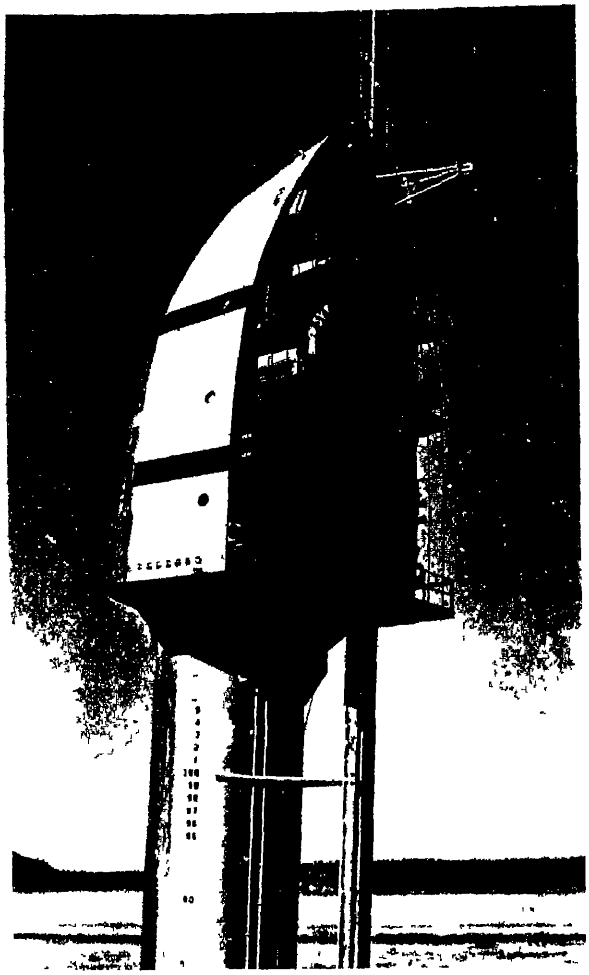

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Figure A-9.—Instrument platforms designed for maximum stability are ballasted to a vertical position while on station.

For some years the Navy has been trying to develop a program that will improve its deep-sea search, rescue, and salvage. Because of the Thresher disaster, highest priority was given to a system for rescuing crewmen from submarines in trouble. This is to be done by the deep submergence rescue vehicle (DSRV). Figure A-11 shows the way in which the DSRV will rescue submarine crews.

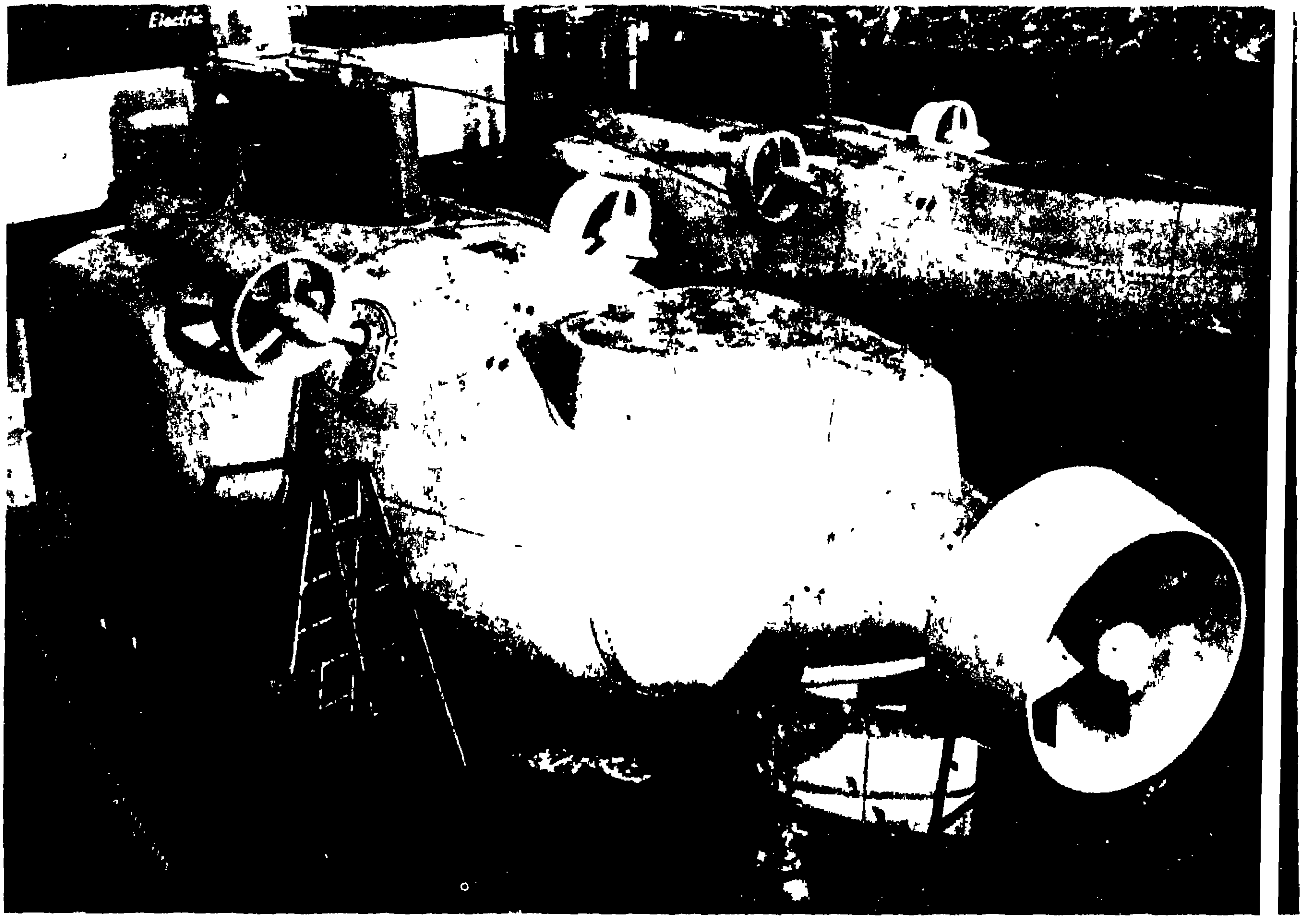

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Figure A-10.—Deep-diving research submarines Sea Cliff and Turtle aboard their surface support ship prior to departure for the Bahama Islands.

Courtesy General Dynamics Electric Boat Division

To complete the picture on oceanographic vessels, the Navy developed platforms for gathering oceanographic data at sea These platforms range from fixed observing stations, such as the "monster" buoy, to satellites for remotely sensing sea conditions

AUTOMATIC DATA PROCESSING

Data processing is a machine-based system in which information is stored, arranged, transformed, and displayed for rapid retrieval according to fields of interest. From a military standpoint, this technology can be applied to such areas as intelligence, logistics, missiles, personnel management, oceanography, electronic countermeasures, space and satellite surveillance, and many others. One great benefit of an ADP system is that, it is possible to rearrange or sort out (retrieve) any of the stored information very rapidly. The computer's ability to quickly assemble and combine huge quantities of data improves management's capability to act promptly.

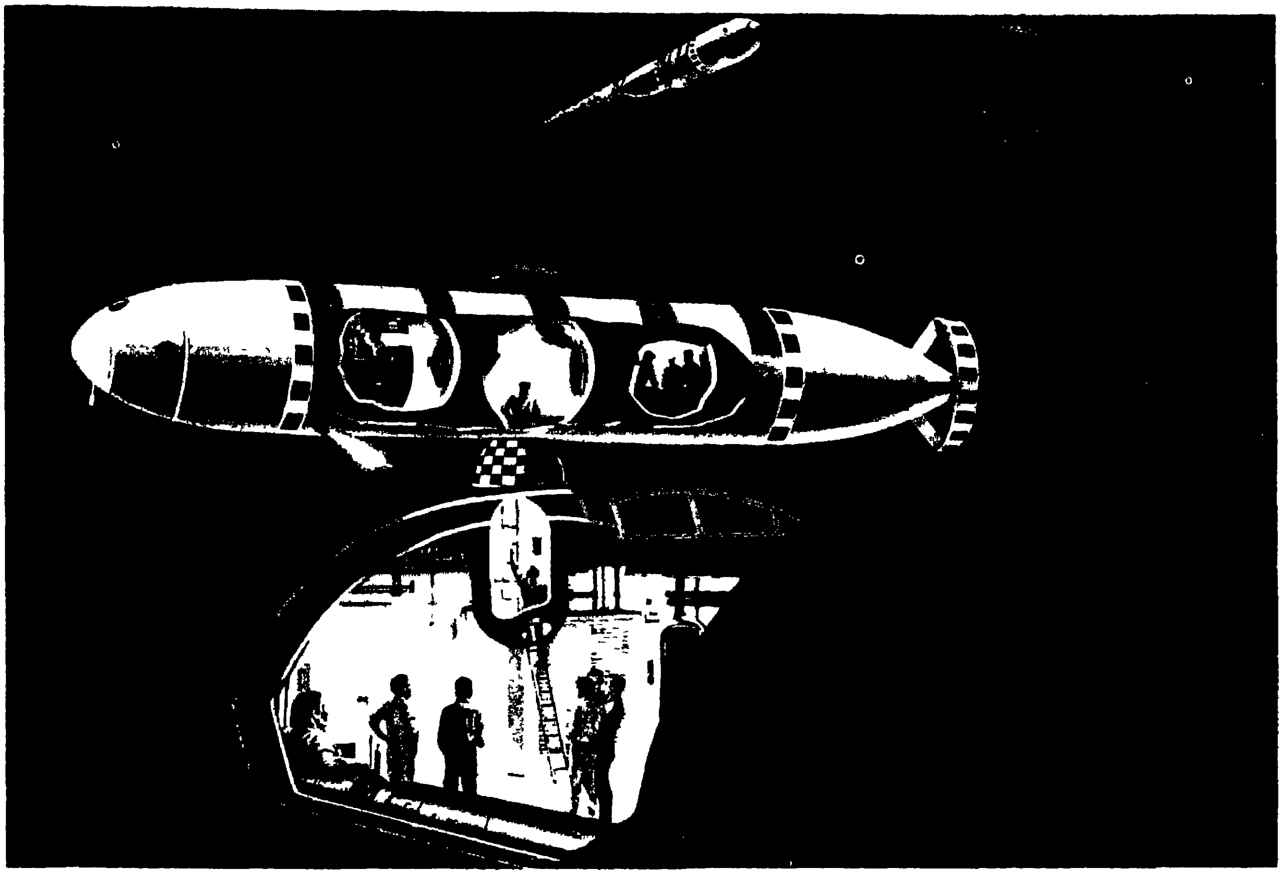

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Figure A-11.—Artist's concept showing the DSRV mated with the escape hatch of a distressed submarine and personnel transferring to the rescue vehicle

The ADP systems are composed of the manual, mechanical, electrical, and electronic data processes required to gather, record, summarize, and present data for whatever purpose is intended. The systems are built around a group of machines or devices that automatically handle most of the data-processing routine.

At least three basic considerations are involved in any data processing system (1) the source data, or input, (2) the working with or processing, of data within the system, and (3) the finished product, or output. The machines and devices that make up an ADP system are classified as either electric (or electronic) accounting machines or electronic data processing systems.

The electric accounting machines (EAMs) usually are used to perform only one operation at a time. Each machine is designed for one specific purpose (e.g., to sort, punch, or print) The work must be shifted between machines for each step in the processing operation. Both input and output data are contained on punched cards.

An electronic data processing system (EDPS) performs both arithmetical (add, subtract, multiply, and divide) and logical operations by means of programmed instructions. It does so at speeds far beyond the capacity of the human brain. The group of machines making up the EDPS provides for automatic data input, storage, computing, and output. The equipment can go through a long series of operations

without help of a human; however, someone must first determine the steps involved and set them down (program the instructions) in language the machine "understands." Information for an EDPS may be recorded on punched cards, paper tape, or magnetic tape, depending on the type of system. Stored data in the machine's "memory" or storage bank may be on tape, drums, or disks (all magnetic).

The question may arise, "If the EDPS is so obviously superior to the EAM, why retain the EAM?"

It is true that the EAM, as compared to an EDPS, can perform only a small number of operations. But some data processing installations have requirements that can be fully met by less costly EAMS. The EAMs may perform accounting functions that, being limited and fairly simple do not warrant the use of a costly electronic system.

Some Applications of ADP

Many EDPS computers can be made to do almost anything that can be expressed as a series of arithmetical operations. But the great advantage of the computer lies in its speed. The average person can add two numbers of six digits each in perhaps 5 seconds. Most computers can solve 50,000 or more of these sums every second As a matter of fact, there are in use today computers that can carry out 10 million additions a second. When we are dealing with only a few numbers, speed of calculation may not be important. When we deal in large amounts of information, however, speed of solution is very important if it is to be of any value.

The great speed that ADP, and particularly the EDPS, now gives the scientist, engineer, manager, and administrator has made possible a large number of advantages. The rest of this section discusses a few of the many applications of ADP in the Navy

PROGRAM EVALUATION AND REVIEW TECHNIQUES.–The Navy's Program Evaluation and Review Technique (PERT) is a computerized procedure for new-program evaluation. It was developed by the Special Projects Office of BuWeps (now NavSea). It was first used to aid managers in planning and controlling the fleet ballistic missile (Polaris) weapon system development program. Today, PERT is one of the better known management information and control techniques. It has found use beyond its original application. It worked so well for the FBM program that PERT is often applied to other development efforts, not only in the Navy, but in the other military services and in the aerospace and construction industries.

The PERT works well for either smaller or large projects. With the assistance of ADP, however, it is in the large, long-range projects where the full benefit of PERT is realized.

As one example of a large project, a new weapon system may require 3 years to complete. In the early phases, at least three supporting systems are considered. These are the missile system (which is only one part of the entire weapon system), the ship system, and the support system. Each supporting system, in turn, is broken down into its components. If the missile system consists of 12 components, the ship system 9 components, and the support system 10, we have a total of 31 separate but related elements under development. Depending on the complexity of the complete weapon system, there could be many more.

Each component may be handled by a different contractor. Each contractor further subdivides his component into the required phases of production within his plant(s)

Under the PERT concept, computer reports are required from all participating Navy activities and industrial contractors on a monthly basis. Also, interim reports are submitted on significant problems. The responsible systems command or other agency combines these reports in a single weapon system computer run to determine if the project is going as scheduled.

Through the use of computers and PERT, responsible officials in the appropriate systems commands are greatly aided in comparing individual reports against the overall program structure. The time thus saved can now be utilized in analysis, planning, and evaluation of their subject areas.

NAVAL TACTICAL DATA SYSTEM.—The Naval Tactical Data System is an electronic computing, display and communications system. It collects, processes, and evaluates very quickly the tactical information needed by command. The heart of the system is a digital type computer. When equipped with NTDS, an entire naval task force can be coordinated almost to the point of operating as one ship. The system expands the idea of instant command decision to global dimensions.

Information coming from the ships sensors and radio communications goes into data processing equipment located on board major combatant ships. Here such functions as detection, location, speed, identity, and size of friendly or enemy vehicles are worked out in computers that form the "brain" of the system. The answers are displayed automatically on scopes installed in the combat information center where command and operating personnel watch the tactical situation and issue required commands. The visual display of the immediate situation, permits key personnel to concentrate on the job of effective weapon assignment to threats against the ships. Computer installations within the task force are interconnected by means of radio equipment employing advanced communication techniques. They exchange the tactical information at high speeds. As a result, the task force commander and individual unit commanders are provided with a complete overall tactical picture

MAINTENANCE DATA COLLECTION.—The Navy Maintenance and Material Management (3-M) system is a standard system of maintenance planning and control for the uniform purpose of preventive maintenance aboard ships and in aircraft squadrons

For the 3-M system to be successful, there must be a good method for enabling operational commanders and the systems commands to carry out their management functions in support of the program. A maintenance data collection (MDC) subsystem for gathering, processing, reviewing, and distributing feedback information is an important element of the 3-M system.

The MDC uses electronic accounting machines installed on many ships, such as tenders, repair ships, aircraft carriers, and stores ships. Manually prepared maintenance documents from individual ships and squadrons are sent to the supporting ship where they are processed into EAM punched cards. From this one set of cards numerous records and reports can be prepared. Tests during the trial run, for example, allowed systems commands to suspend 18 manually prepared records.

A valuable asset of the system is the information furnished by MDC. It shows, for example, how equipment failed, how it was repaired, the parts needed, and the repair time involved. With these things known, it is possible to decide whether equipment should be kept or replaced. By analyzing MDC recordings, management can determine whether a particular required maintenance check is performed too often or is perhaps not required at all.

MANAGEMENT INFORMATION SYSTEMS.—When first introduced to management, the computer served managers only in systems such as accounting and payroll. ADP sites gradually were established in many separate activities—supply, comptroller, production, research, and administrative departments. Because each command directed and controllled its own ADP program, each activity developed its own requirements for ADP equipment. It designed and installed its own financial, production, supply, personnel, and other systems Systems techniques, computer languages, and computer products (types of information provided) differed at each command even though missions were similar to those at other local commands. As a result, individual systems were not providing information that could be combined for higher levels of Navy management. The Navy needed to benefit from the increasing availability of information and the rapidly expanding computer science. Over the last several years, it has concerned itself with developing information systems to serve top management as well as functional managers. As a first step, direction and control of major ADP systems have been transferred from field command levels Thus, many levels of management are served without duplication and higher levels of management are provided with automated decision information.

Department of the Navy Management Information and Control System (DONMICS).–During the last 10 years a lack of coordination has characterized the introduction of most of the 700-plus computers now used by the Navy. Not inter-relating the early systems was caused by (1) limitations in the state of information sciences technology, and (2) lack of sophistication in our understanding of information systems potential. This holds true throughout Government and industry.

Based on experience in using Departmental computerized information, SecNav, in February 1967, directed that steps be taken to develop a Department of the Navy Management Information and Control System. DONMICS involves a long-range planning effort for the combining of the hundreds of information systems in the Navy and Marine Corps. The target date is a decade-plus in the future. The concept, therefore, is subject to many changes. For that reason, a lengthy discussion of DONMICS at this time would serve no useful purpose.

MISCELLANEOUS APPLICATIONS.–The Navy uses electronic computers in many operational, planning, design, and research (fig. A-12) activities. There is a constant stream of

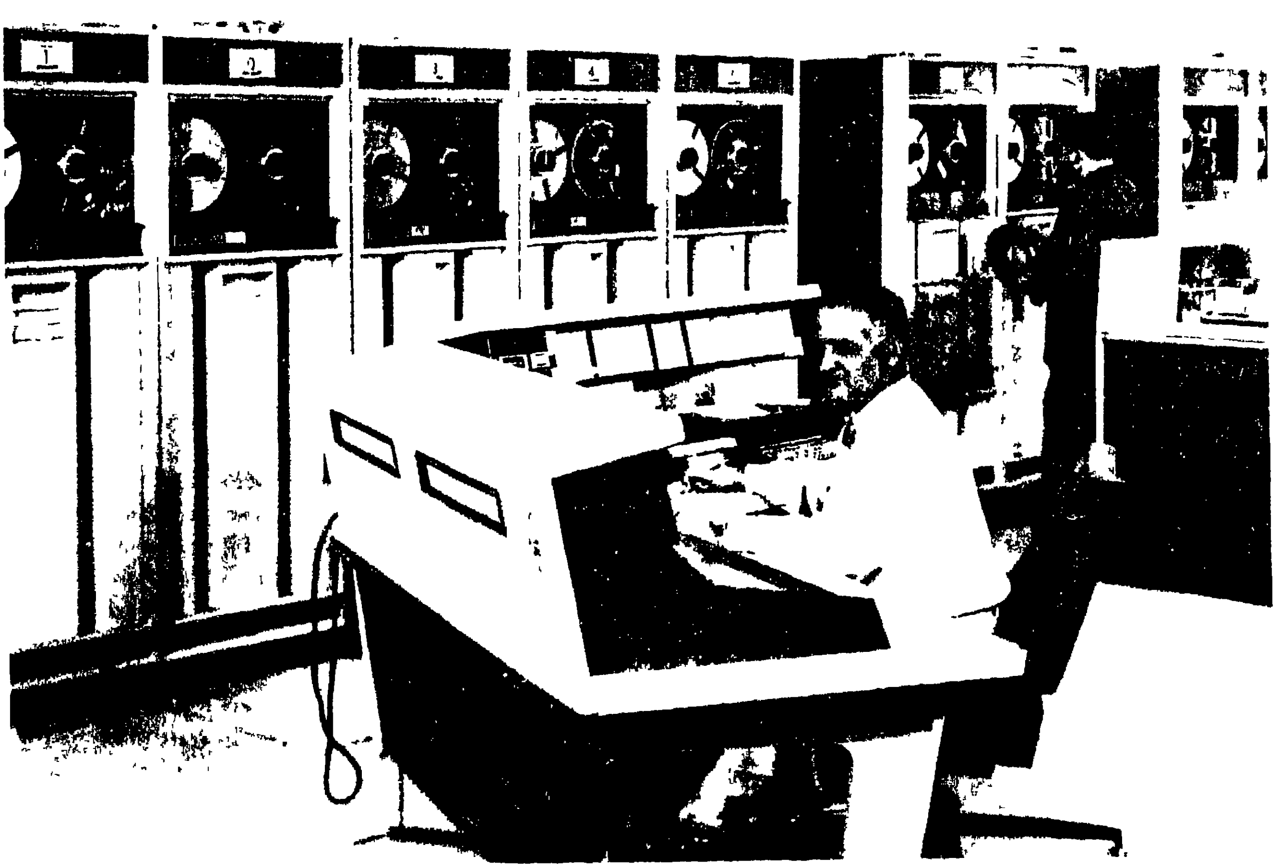

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Figure A-12.–A general purpose digital computer used for scientific computations at the Naval Research Laboratory.

new uses, new high-speed computers, and new computer methods.

Electronic computers have become vital in Navy management operations where they are used in many ways

In inventory management, computers calculate and monitor allowance lists, speed up the provisioning process, formulate load lists; help requisition control; and determines material readiness. A good example of the last is the 3-M system described earlier.

Management applications also involve the requirement, use, location, and assignment of personnel. The Marine Corps uses computers to help recruits from basic training to their first duty station. BuPers is studying ways of doing something similar with the larger, more difficult problem of identifying billets in which men will serve most effectively.

The Navy Automated Research and Development Information System is a computer-aided management function. It uses and keeps up to date the data on all R&D sponsored by the Navy Department. This ensures rapid availability of any scientific, engineering, and administrative information in that field.

In the area of training, computer aided instruction (CAI) has proven effective. Utilizing CAI, each student uses a typewriter to maintain contact with a computer. The machine provides textbook-type information and asks questions which are answered by the student The Naval Academy is using CAI to instruct midshipmen in foreign languages, engineering and mathematics. Activities concerned with training or educating large numbers of naval personnel, such as the Naval Air Technical Training Command at Memphis and the Naval Training Research Laboratory at San Diego, are experimenting with CAI.

The Naval Ship Engineering Center has developed a computer-aided ship design and construction procedure that aids in the conceptual design of a new ship. Then, by representing the hull in digital terminology, it creates several models of the ship based on required speed, power, general characteristics, and so on.

In universities and industrial laboratories sponsored by the Navy, almost every major scientific program has a back-up computer operation either locally or time-shared by remote control.

Even though we have a variety of computers, the Navy is interested in new and different machines. Evolution improvements are expected, but our concern is with basic research leading to revolutionary advances. There are at least three reasons for this, all stemming from the Navy's operational needs.

First, in spite of the amazing speed and capacity of todays equipment, several classes of problems are simply too large to be solved by them in reasonable time, if at all.

A second problem is that of cost. In terms of money, a large-scale machine may cost several million dollars. The cost, however, is not measured in money alone. Aboard ship, in aircraft, and in artificial satellites, weight and space are very important. Today's large general-purpose computer is not a small machine. Another cost, one less easily measured, is that of reliability. This is the problem of maintenance, repair, and failure. Most serious in the eyes of the operational Navy is the cost in time required to solve a problem on a computer. Today's machines are such that we spend a great deal of time figuring out what to tell them to do and then telling them how to do it. Modern command-control systems require several hundred man-years of programming effort. Unless a commander's questions are foreseen weeks or months ahead of time, they might as well not be asked because the solution methods can't be programmed fast enough.

The third reason for our interest in new machines lies in our inability to solve some types of problems by computer Unless a problem can be defined explicitly and its method of solution outlined in detail, it generally cannot be handled by a computer

NAVAL COMMUNICATIONS

Communications is very important to the Navy and other armed services. It is the key to command. Without proper communications, coordinated action would be impossible.

Communications makes it possible for the commander to evaluate the situation and to control his units. In this section you will study tactical communications, which involves only short distances. It is the way in which ships and aircraft talk to one another. The larger idea of worldwide communications will be studied later. The methods used for tactical communication may depend on a number of things—desired degree of security, whether it is day or night, required speed of sending, and so on.

METHODS OF COMMUNICATING

Although the Navy normally employs only three methods to communicate visually (flashing light, semaphore, and flaghoist), other methods of communications available are wigwag, sound, and pyrotechnics. Wigwag uses a handheld flag and is seldom used because semaphore is faster. Sound is used mainly for fog warning and maneuvering signals, although other sound signals are applicable to convoy and emergency situations. Pyrotechnics are mainly for emergency communications.

FLASHING LIGHT

Directional flashing light can be pointed and trained so as to be visible only by one addressee. When signaling with nondirectional flashing light, the operator forms the dots and dashes with a telegraph key that switches the yardarm lights on and off

In wartime, flashing light that must be carried on after dark usually is conducted by means of infrared type lights These are invisible unless viewed through a special receiver device. Transmissions can be either directional or nondirectional During darkness, infrared is the most secure means of visual communications

SEMAPHORE

Semaphore and flashing light can be used interchangeably. Semaphore is much faster and generally more secure than flashing light for short-distance transmissions in clear daylight. It may be used to send messages to several addressees at once if they are in suitable positions. Because of its speed, semaphore is better adapted for long messages than are other visual methods.

FLAGHOIST

Flaghoist signaling provides a rapid and accurate system of handling tactical signals of short length during daylight. In general, a flaghoist signal ensures a more uniform dispatch of a maneuver than any other system.

PYROTECHNIC, SOUND, AND WIGWAG

Use of pyrotechnics for communications is limited to certain kinds of signals and emergency signals. Theater, operational, and tactical commanders, however, may authorize additional meanings if these cannot be confused by forces not taking part in the operation or exercise.

Sound systems include whistles, sirens, bells, and sonar. The first three are used by ships for sending emergency warning signals such as air raid alerts, for navigational signals defined by the Rules of the Road, and, in wartime, for communication between ships in convoy.

A sonar-equipped ship with an underwater telephone system can utilize the system to communicate by continuous wave (CW), or by voice. (CW employs electronic means to transmit Morse code, figure A-13.) This sound system has the same range limitation as a visual method and is considered less secure

Wigwag is a method of signaling whereby a single flag is used to represent the dots and dashes of the Morse code, depending upon the positioning of the flag in relation to the sender. This method of signaling is seldom used in present-day communications

GENERAL PROCEDURES

Visual communication procedures may be subdivided into Allied, international, and special procedures.

Allied procedures are those employed by the armed forces of all allies of the United States.

International procedures are those used by most nations of the world. This includes

LETTER	
A	. –
B	– . . .
C	– . – .
D	. – . .
E	.
F	. . – .
G	– – .
H	. . . .
I	. .
J	. – – –
K	– . –
L	. – . .
M	– –
N	– .
O	– – –
P	. – – .
Q	– – . –
R	. – .
S	. . .
T	–
U	. . –
V	. . . –
W	. – –
X	– . . –
Y	– . – –
Z	– – . .
NUMBER	
1	. – – – –
2	. . – – –
3	. . . – –
4	. . . . –
5	. . . . .
6	– . . . .
7	– – . . .
8	– – – . .
9	– – – – .
0	– – – – –
PUNCTUATION	
APOSTROPHE	. – – – – .
COLON	– – – . . .
COMMA	– – . . – –
HYPHEN	– . . . . –
PARENTHESIS, LEFT	– . – – .
PARENTHESIS, RIGHT	– . – – . –
PERIOD	. – . – . –
QUESTION MARK	. . – – . .
QUOTATION MARKS	. – . . – .
SLANT SIGN/VIRGULE	– . . – .

Figure A-13.—Formation of characters in Morse code.

military, civil, governmental, and other fixed and mobile communication stations.

Special signal procedures include those used by wartime Allied convoys, and—

1. Signals for various foreign ports.
2. U.S. Navy and Allied fleet exercise signals.
3. Shipwreck signals.
4. Ship-shore movement (amphibious) signals.
5. Harbor tug control signals.
6. Visual aircraft control.
7. The international signal NMM, which refers to foreign port signals in Sailing Directions.

The foundation for these signal procedures is contained in. ACP 129, *Visual Signaling Procedures,* ACP 148, *Wartime Instructions for Merchant Ships (Visual Signaling and Tactics),* ATP 1(A), Vol. II, *Allied Naval Signal Book;* and H.O. 103, *International Code of Signals,* Vol. I.

FLASHING LIGHT PROCEDURE

When calling another station, there are certain details for which you are responsible. In visual communications the identity of the calling station usually is known, and it is necessary only to gain the attention of the station called. Normally, this is done by directing the signal light at the station and making the receiving station's call sign until answered.

INFRARED COMMUNICATIONS

Infrared flashing light communications between ships generally are directional, although nondirectional procedure can be used for traffic having a wide distribution.

The OTC (officer in tactical command) may prescribe calling periods and instructions for traffic delivery. Normally, certain times are set aside for infrared communications for which there is traffic. When a message must be transmitted outside of a regularly scheduled time, the addressee may be alterted by the signal "Nancy Hanks" on the voice radio. This is a very

short message consisting of (1) the voice call sign of station called, (2) voice call sign of station calling, and (3) the message, e.g., ADAM–THIS IS FOXFIRE–NANCY HANKS–OVER.

At scheduled times or when alerted by voice radio, ships switch on their infrared point-of-train light (POT) to assist senders or receivers in locating them and keeping their lights properly trained during transmission.

FLASHING TO AIRCRAFT

When signaling is taking place between aircraft in flight and the ground (or surface vessels), the following points must be borne in mind:

1. Visual signaling from aircraft is possible only when the aircraft occupies certain positions relative to the line of sight from the station with which signaling is taking place. Owing to rapid aircraft movement, the time during which the aircraft is in favorable positions for signaling is very short.
2. The signaler in an aircraft may have no one to write down the message for him. He must read the entire message and write it down from memory, or write down each word before sending a flash.
3. For long messages it may be advisable, therefore, to use the double-flash procedure.
4. The aircraft should be maneuvered into a favorable position so that the signaler can view the receiver for as long a period as possible

SEMAPHORE PROCEDURES

Semaphore signaling procedures are similar to those used in flashing light Because of the different equipment used, some differences in procedure do exist.

Semaphore is more secure than flashing light because of the short range at which it is visible. Semaphore normally can be read only when facing the sender, and in this respect is of limited value in nondirectional signaling. Semaphore can be employed at night by attaching wands to flashlights, using these to replace the hand flags.

For greatest range in semaphore signaling, choose a good background. Some ships have special screens making the flags more noticeable. The position of the flags may become confused against a cluttered background, for this reason, a smooth background is best.

SOUND SIGNALING

Sound may be used in maneuvering ships either as a supplement to flag signals or as a separate signal. Because of the equipment needed, sound signaling in Morse code is slow. For this reason, the practice of sound signaling is held to a minimum. Signals other than single-letter signals should be used only in extreme emergencies.

VOICE RADIO

Radiotelephone, commonly known as voice radio, is an effective and easy method of naval communications. It is used for ship-to-ship tactical communication, for convoy work, for control of airborne aircraft, and for many tasks where rapid short-range communications are needed. Small vessles rely entirely upon radiotelephone.

Voice radio adds to both radiotelegraph and visual methods of communications. It does not replace either. It has the advantages of simplicity of operation and direct transmission of the spoken word, but ease of operation has led to abuse Careless use of voice procedure, plus overloaded circuits, leads to much confusion at times when good communications are imperative. For this reason, it is very important that correct procedures be used.

MESSAGE PRECEDENCE

There are many things to learn about naval communications. The procedures outlined above are very brief. They are intended to give you only first look at communications methods There are very complicated procedures which tell you how to put together a message, how to handle a message, and how to read a message

These you will study later in detail. There is one part of a naval message which is not found in civilian messages, and that is the precedence. Every naval message has a precedence, which tells everyone concerned how the message is to be handled. Certain messages are just more important than others, and the precedence is the senders way of indicating the importance of his message. There are four precedence designations. These are:

FLASH

IMMEDIATE

PRIORITY

ROUTINE

Each of these designations has particular meaning and requires certain handling. These are shown in figure A-14. You should become familiar with these designations.

COMMUNICATION SUMMARY

"Success of communication depends primarily upon knowledge of how, when, and where to send timely and intelligible messages and this can be gained only through a common understanding on the part of those directly concerned in the vital business at hand. Communication personnel have an important place in the ship's command organization."

SHIPBOARD ORGANIZATION

A warship's crew is composed of officers and men as are necessary for the ship to fight well. The ship's organization is a war organization. Warships should operate in peacetime with an organization that can be expanded quickly when a wartime operating condition becomes necessary. It is based on a grouping of personnel that is intended to reduce the possible overlapping of jobs and the duplication of personnel.

Guidance in the preparation of the standard ship's organization for all types of ships is provided by the effective edition of NWP 50, *Shipboard Procedures.*

ADMINISTRATIVE ORGANIZATION

The basic shipboard departments are navigation, operations, weapons (or deck), engineering, and supply. There may be a number of others, however, as can be seen in figure A-15.

Shipboard procedures NWP-50, serves as a guide for type commanders in preparing administrative and battle organizations for their ships. A type commander has command of a group of ships of a particular type or types. For example, Commander Naval Surface Force, U.S. Atlantic Fleet and Commander Submarine Force, U.S. Pacific Fleet.

In preparing type organizations, type commanders allow for missions of the type and the quality and number of personnel available. Administrative and battle organizations prepared by corresponding type commanders in different fleets are coordinated through their fleet commanders. They are made similar for the same types and classes of ships. The organization shown in this chapter is that of a large fighting ship

COMMANDING OFFICER

The responsibility of the commanding officer for his command is absolute. His authority is equal with his responsibility, subject to the limitations prescribed by law and regulations While he may give authority to his subordinates, such giving of authority in no way relieves the commanding officer of his responsibility for the safety and efficiency of his entire command.

In the execution of his duties, the commanding officer is helped by the executive officer, who acts as his direct representative.

The commanding officer must strive to maintain his command in a state of maximum readiness for war service. He issues the necessary directions to his executive officer who, prepares

Prosign	Designation	Definition and Use	Handling Requirements
Z	FLASH	FLASH precedence is reserved for initial enemy contact messages or operational combat messages of extreme urgency. Brevity is mandatory. Examples (1) Initial enemy contact reports. (2) Messages recalling or diverting friendly aircraft about to bomb targets unexpectedly occupied by friendly forces, or messages taking emergency action to prevent conflict between friendly forces. (3) Warnings of imminent large-scale attacks. (4) Extremely urgent intelligence messages (5) Messages containing major strategic decisions of great urgency.	FLASH messages are hand-carried, processed, transmitted, and delivered in the order received and ahead of all other messages. Messages of lower precedence will be interrupted on all circuits involved until handling of the FLASH message is completed. Time Standard Not fixed. Handled as fast as humanly possible with an objective of less than 10 minutes.
O	IMMEDIATE	IMMEDIATE is the precedence reserved for messages relating to situations that gravely affect the security of national/allied forces or populace, and require immediate delivery to the addressee(s) Examples (1) Amplifying reports of initial enemy contact. (2) Reports of unusual major movements of military forces of foreign powers in time of peace or strained relations (3) Messages that report enemy counterattack or request or cancel additional support. (4) Attack orders to commit a force in reserve without delay. (5) Messages concerning logistical support of special weapons when essential to sustain operations. (6) Reports of widespread civil disturbance. (7) Reports or warnings of grave natural disaster (earthquake, flood, storm, etc). (8) Requests for, or directions concerning, distress assistance. (9) Urgent intelligence messages	IMMEDIATE messages are processed, transmitted, and delivered in the order received and ahead of all messages of lower precedence. If possible, messages of lower precedence will be interrupted on all circuits involved until the handling of the IMMEDIATE message is completed. Time Standard 30 minutes to 1 hour.
P	PRIORITY	PRIORITY is the precedence reserved for messages that require expeditious action by the addressee(s) and/or furnish essential information for the conduct of operations in progress when ROUTINE precedence will not suffice. Examples (1) Situation reports on position of front where attack is impending or where fire or air support will soon be placed. (2) Orders to aircraft formations or units to coincide with ground or naval operations (3) Aircraft movement reports (messages relating to requests for news of aircraft in flight, flight plans, or cancellation messages to prevent unnecessary search/rescue action). (4) Messages concerning immediate movement of naval, air, and ground forces.	PRIORITY messages are processed, transmitted, and delivered in the order received and ahead of all messages of ROUTINE precedence. ROUTINE messages being transmitted should not be interrupted unless they are extra long and a very substantial portion remains to be transmitted. PRIORITY messages should be delivered immediately upon receipt at the addressee destination. When commercial refile is required, the commercial precedence that most nearly corresponds to PRIORITY is used. Time Standard 1 to 6 hours.
R	ROUTINE	ROUTINE is the precedence to use for all types of messages that justify transmission by rapid means unless of sufficient urgency to require a higher precedence Examples (1) Messages concerning normal peacetime military operations, programs, and projects (2) Messages concerning stabilized tactical operations. (3) Operational plans concerning projected operations. (4) Periodic or consolidated intelligence reports (5) Troop movement messages, except when time factors dictate use of a higher precedence. (6) Supply and equipment requisition and movement messages, except when time factors dictate use of a higher precedence. (7) Administrative, logistic, and personnel matters.	ROUTINE messages are processed, transmitted, and delivered in the order received and after all messages of a higher precedence. When commercial refile is required, the lowest commercial precedence is used. ROUTINE messages received during nonduty hours at the addressee destination may be held for morning delivery unless specifically prohibited by the command concerned. Time Standard· 3 hours — start of business following day.

76.44

Figure A-14.—The precedence of a message indicates its relative importance. Note time standards for handling.

Prosign	Designation	Definition and Use	Handling Requirements
Z	FLASH	FLASH precedence is reserved for initial enemy contact messages or operational combat messages of extreme urgency. Brevity is mandatory. Examples· (1) Initial enemy contact reports. (2) Messages recalling or diverting friendly aircraft about to bomb targets unexpectedly occupied by friendly forces, or messages taking emergency action to prevent conflict between friendly forces. (3) Warnings of imminent large-scale attacks (4) Extremely urgent intelligence messages. (5) Messages containing major strategic decisions of great urgency.	FLASH messages are hand-carried, processed, transmitted, and delivered in the order received and ahead of all other messages. Messages of lower precedence will be interrupted on all circuits involved until handling of the FLASH message is completed. Time Standard. Not fixed. Handled as fast as humanly possible with an objective of less than 10 minutes.
O	IMMEDIATE	IMMEDIATE is the precedence reserved for messages relating to situations that gravely affect the security of national/allied forces or populace, and require immediate delivery to the addressee(s). Examples (1) Amplifying reports of initial enemy contact. (2) Reports of unusual major movements of military forces of foreign powers in time of peace or strained relations (3) Messages that report enemy counterattack or request or cancel additional support. (4) Attack orders to commit a force in reserve without delay. (5) Messages concerning logistical support of special weapons when essential to sustain operations (6) Reports of widespread civil disturbance (7) Reports or warnings of grave natural disaster (earthquake, flood, storm, etc). (8) Requests for, or directions concerning, distress assistance. (9) Urgent intelligence messages	IMMEDIATE messages are processed, transmitted, and delivered in the order received and ahead of all messages of lower precedence. If possible, messages of lower precedence will be interrupted on all circuits involved until the handling of the IMMEDIATE message is completed. Time Standard 30 minutes to 1 hour.
P	PRIORITY	PRIORITY is the precedence reserved for messages that require expeditious action by the addressee(s) and/or furnish essential information for the conduct of operations in progress when ROUTINE precedence will not suffice. Examples (1) Situation reports on position of front where attack is impending or where fire or air support will soon be placed (2) Orders to aircraft formations or units to coincide with ground or naval operations (3) Aircraft movement reports (messages relating to requests for news of aircraft in flight, flight plans, or cancellation messages to prevent unnecessary search/rescue action). (4) Messages concerning immediate movement of naval, air, and ground forces.	PRIORITY messages are processed, transmitted, and delivered in the order received and ahead of all messages of ROUTINE precedence. ROUTINE messages being transmitted should not be interrupted unless they are extra long and a very substantial portion remains to be transmitted. PRIORITY messages should be delivered immediately upon receipt at the addressee destination. When commercial refile is required, the commercial precedence that most nearly corresponds to PRIORITY is used. Time Standard. 1 to 6 hours.
R	ROUTINE	ROUTINE is the precedence to use for all types of messages that justify transmission by rapid means unless of sufficient urgency to require a higher precedence Examples (1) Messages concerning normal peacetime military operations, programs, and projects (2) Messages concerning stabilized tactical operations (3) Operational plans concerning projected operations. (4) Periodic or consolidated intelligence reports. (5) Troop movement messages, except when time factors dictate use of a higher precedence (6) Supply and equipment requisition and movement messages, except when time factors dictate use of a higher precedence. (7) Administrative, logistic, and personnel matters	ROUTINE messages are processed, transmitted, and delivered in the order received and after all messages of a higher precedence. When commercial refile is required, the lowest commercial precedence is used. ROUTINE messages received during nonduty hours at the addressee destination may be held for morning delivery unless specifically prohibited by the command concerned. Time Standard 3 hours — start of business following day.

76.44

Figure A-14.—The precedence of a message indicates its relative importance. Note time standards for handling.

and conducts exercises and drills required to bring about the necessary readiness.

A main responsibility of the commanding officer at all times is the safety of the ship. This means issuing orders regarding the handling, stowage, and use of ammunition; making sure the ship is watertight, which involves closing watertight doors, careful navigation; posting of proper lookouts, showing required lights; observing Rules of the Road to prevent collisions; taking soundings to check with the plotted position of the ship; and so on. It is impossible for the captain to attend to all these matters personally. But while the navigator, for example, is charged with the specific duty of knowing the ship's position at all times, the commanding officer is still ultimately responsible for safe navigation. He alone is responsible for the safety and efficiency of the ship.

The details of training and education of the ship's crew are jobs that the commanding officer gives to his executive officer. All ships must have a program for shipboard training.

During action, the commanding officer is required to take on the enemy and fight to the best of his ability. He must not give up until the action is complete.

The commanding officer's battle station is that station from which he can best fight the ship. In case of the loss of his ship, both custom and regulations require that the commanding officer assure that all personnel are off the ship before he leaves.

The welfare and living conditions of the crew are a commanding officer's constant concern. The medical officer assists him in keeping the ship in a sanitary condition, and provides for proper care in cases of infectious disease.

EXECUTIVE OFFICER

The executive officer is an aide to the commanding officer. He is assigned as such by the Chief of Naval Personnel from officers of the line. As the second highest ranking officer aboard ship, he is the direct representative of the commanding officer. The executive officer has no authority except that of the commanding officer. The details of his duties are regarded as the carrying out of the captain's orders. All heads of departments and other officers and enlisted men are under the executive officer's orders.

Under the commanding officer, the executive officer is responsible for such matters as—

1. Coordination and supervision of all departments.
2. Maintenance of morale, welfare, and discipline.
3. Assignment of personnel and maintenance of their records.
4. Prepare and maintain the ship's bills and orders.
5. Supervision and coordination of work, exercises, training, and education.
6. Supervision of loading and berthing plans.
7. Supervision of ship's correspondence.

With the help of department heads, the executive officer coordinates all ship's work. This includes drills and exercises, the personnel organization, policing of the ship, and inspections of the ship. He is responsible for maintenance of cleanliness, good order, and the trim appearance of ship and crew.

The executive officer keeps in close touch with all happenings of the ship. He supervises department heads in the doing of their duties, including the instruction of junior officers.

The executive officer is responsible for the accuracy of entries made in the crew's service records. He investigates matters involving conduct and problems of discipline, and he approves all liberty and leave

He exercises supervision whenever all hands are called for any particular duty, except during action. Except on small ships, he is not required to stand a watch but he may relieve the officer of the deck for short periods.

Executive's Assistants

The standard ship's organization for each type of ship shows the personnel that may be working under the executive officer to assist him in the performance of his duties. The size of the organization depends on the size of the ship.

These assistants, along with a description of their basic duties, are as follows:

The administrative assistant assists the executive officer in details of administration.

The personnel officer assigns enlisted personnel aboard the ship. He is responsible for the administration and custody of enlisted service records. The billets of personnel officer and administrative assistant may be combined.

The educational services officer helps the executive officer in running the shipboard educational programs. He publicizes educational opportunities available and helps those who wish to enroll in courses.

The ship's secretary is responsible for the administration of ship's correspondence and directives. He is also responsible for the custody of officers' personnel records. As captain's writer, he supervises preparation of the commanding officer's personal correspondence. The ship's secretary normally is a junior officer; on small ships he may be a senior petty officer in one of the clerical ratings.

The chaplain, is responsible for the performance of all duties relating to religious activities of the command (fig. A-16). He also attends to the spiritual needs of ship's personnel.

A training officer may be designated by the commanding officer to help the executive officer in training duties as set forth in NWP 50. He assists in training policies, in establishing the training program, and in the preparation of

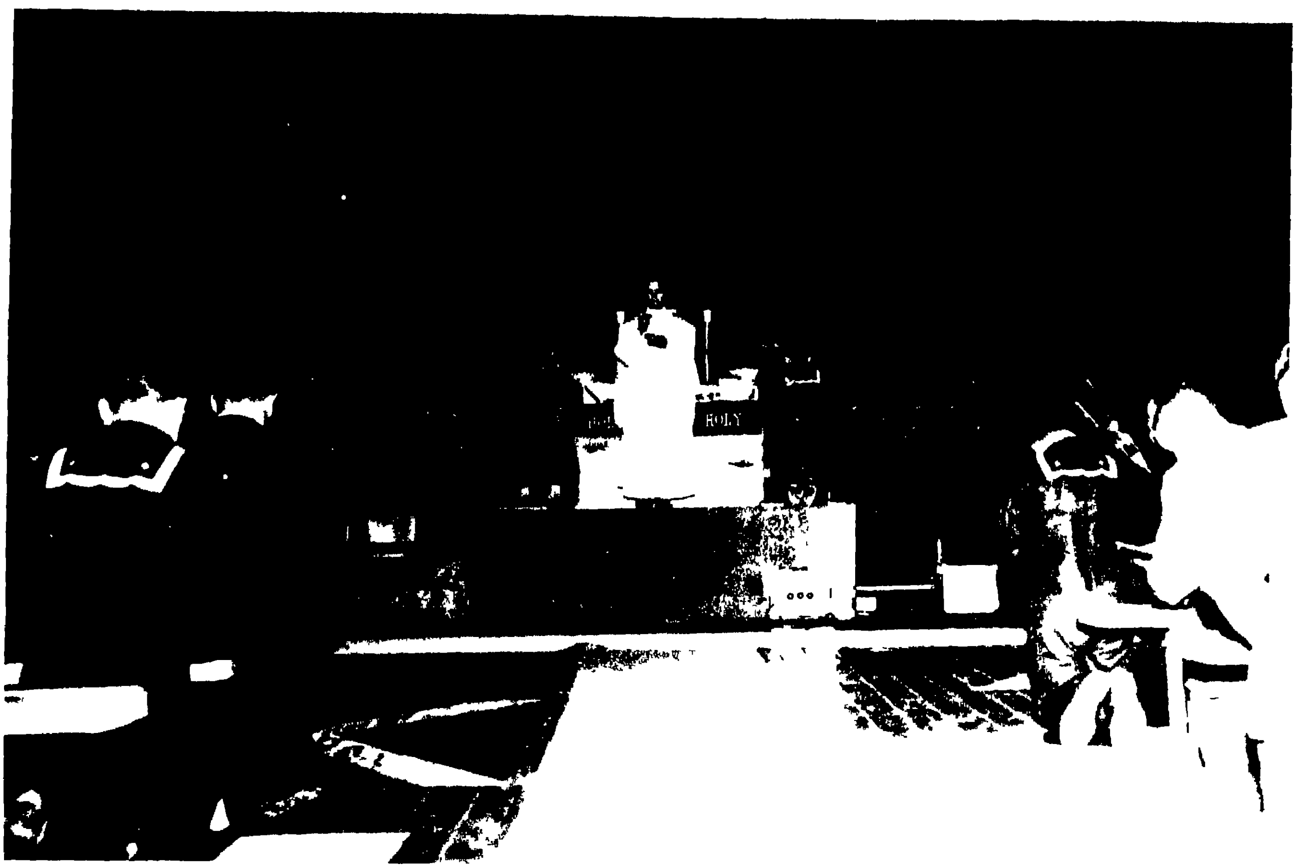

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Figure A-16.—The primary responsibility of the chaplain is to minister to the spiritual needs of command personnel. Here the ship's chaplain celebrates midnight mass.

training courses for training both officers and enlisted men.

The legal officer functions as an adviser and staff assistant to the commanding officer and executive officer concerning the Uniform Code of Military Justice, the *Manual for Courts-Martial,* and other written military law.

The public affairs officer carries out the public affairs program of the ship. His main duties are to keep the commanding officer and executive officer informed about public relations.

The principal responsibility of the postal officer is to ensure efficient mail service to the command.

The combat cargo officer on amphibious type ships helps the executive officer in matters concerning loading and unloading of troops; loading, stowage, and unloading of troop cargo; billeting and messing of troops; and working with troop units ashore.

The special services officer administers the special services program of the ship. This includes all organized welfare, recreational, and athletic activities not assigned to other officers or departments.

The senior watch officer is responsible to the commanding officer for assignment and general supervision of all deck watch standers. He directs the training of deck watch officers. He prepares officer deck watch bills for the commanding officer's approval and enlisted deck watch bills for the executive officer's approval.

The chief master-at-arms, normally senior chief petty officer on board, is responsible for enforcement of regulations, maintenance of good order and discipline, and the security and welfare of brig prisoners.

HEADS OF DEPARTMENTS

The number of departments included in a shipboard organization depends on the type of ship. As seen figure A-15, departments are grouped together as either command or support departments. Normally, an officer heading a command department is a line officer eligible to exercise command in the event of the loss of his superior officers. In aircraft carriers, operations and air departments are headed by naval aviators.

The head of a department is the representative of the commanding officer. All persons assinged to the department work for him and all orders issued by him are obeyed accordingly. In the performance of his duties as a head of department, he follows the orders of the commanding officer. Department heads have certain common duties and responsibilities.

A department head reports to the commanding officer for the readiness of his department. He reports to the executive officer for administrative matters and keeps the executive officer informed of direct reports made to the commanding officer.

In small commands, an officer may be assigned as head of more than one department.

Heads of departments and their principal assistants are assigned battle stations where they can best supervise and control the performance of their men.

Operations Officer

The operations officer is responsible for the collection and evaluation of combat and operational information (fig. A-17).

Functions of the operations department include--

1. Conduct of surface and air search.
2. Execution of electronic warfare.
3. Control of aircraft when in the air, except when this control is assigned to other authority.
4. Collection and analysis of intelligence information
5. Preparation of operation plans and training schedules.
6. Conduct of underwater search and torpedo detection except on ships with antisubmarine armament installed.
7. Maintenance and repair of all electronic equipment of the ship except as assigned to another department.
8. Collection, determining value, and publish meteorological information.
9. The function of the communication department, if in fact the ship has one.

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Figure A-17 —The operations officer is responsible for the collection and dissemination of combat and operational information. Here personnel assist his combat information center officer by manning a plotting board (right) and status boards.

In addition to the normal departmental administrative and training assistants, the operations officer may be assisted by the—

1. Air operations officer
2. Air intelligence officer.
3. Meteorological officer.
4. Combat information center officer.
5. Communication officer (when not a department head).
6. Electronic material officer.
7. Electronic warfare officer.
8. Photographic officer.
9. Antisubmarine warfare officer (only on ASW carriers).

Communication Officer

In most ships the communication officer is a division officer in the operations department. In some large ships he is a department head responsible directly to the commanding officer.

The communication officer is responsible for all visual and electronic outside communications and communication equipment. He is responsible for the proper internal use of incoming messages and for the routing and delivery of outgoing messages. He must be familiar with current tactical and communication publications. He is directly in charge of communication watch and signal

officers. He should have at least a basic knowledge of the technical aspects of communication equipment (fig. A-18). He supervises the handling of Registered Publications System (RPS) material issued to the ship. He is responsible for cryptographic operations.

Navigator

The navigator is directly responsible to the commanding officer for safe navigation and piloting of the ship (although on small ships the navigation department is part of the operations department). Duties of the navigator are as follows:

He advises the commanding officer and the officer of the deck as to the ship's location. In order to carry out this part of his responsibilities, he must mainain a correct plot of the ship's position (fig. A-19) by stars, visual, electronic, or other means. He must give careful attention to the course of the ship and the depth of water when approaching land or shoals. He maintains record books of all observations for the purpose of navigating the ship. He reports in writing to the commanding officer the ship's position at certain times, and at such other times as the commanding officer may request. He keeps corrected and up to date all navigational charts, sailing directions, light lists, and other publications and devices for navigation.

He is responsible for operation, care, and maintenance of the navigational equipment. To this end he is required to determine daily, when

158 30

Figure A-18.—The communication officer, while he need by no means be a technician, is expected to acquire at least a fundamental knowledge of the technical aspects of shipboard communication equipment.

134 69
Figure A-19.—Plotting a course in the chart room. The navigator, who is responsible to the commanding officer for safe navigation of the ship, must maintain an accurate plot of the ship's position.

the ship is underway and weather conditions permit, the error of the gyro and standard compasses. He compensates the magnetic compasses and prepares tables of deviations He is responsible for the accuracy of the ship's chronometers and clocks

Weapons Officer (or First Lieutenant)

With the exception of attack aircraft carriers (CVAs), which have both, all ships have either a weapons or a deck department.

Ships (other than CVAs) mainly concerned with offense through ordnance or aircraft have a weapons department headed by a weapons officer. His job also includes deck seamanship. The weapons officer is assisted by the first lieutenant. Other ships have a deck department headed by the first lieutenant who is assisted by the weapons officer. In small ships the duties of the two billets may be combined.

Aviation units regularly attached to a ship not having an air department are assigned to the weapons department. These units retain their basic organization even when so assigned. An embarked Marine detachment is assigned to the weapons or deck department.

Some of the most important tasks of the weapons officer or first lieutenant are safety precautions necessary in the handling and

stowage of ammunition. He must be sure that safety orders are posted and that personnel obey them. Thorough instruction and frequent drills in safety measures are required of him. Inspections and tests of ammunition and ammunition spaces are his responsibility. He is also responsible for explosives, and for the operation, care, and maintenance of armament, electronic equipment, mine warfare equipment, and antisubmarine equipment when not otherwise assigned.

In the area of deck seamanship, the weapons officer or first lieutenant is responsible for loading and unloading operations. He is also responsible for supervising and directing deck seamanship operations and the upkeep of the ship's boats.

The following officers may assist the weapons officer or first lieutenant (bearing in mind that, except in CVAs, the first lieutenant always is an assistant to the weapons officer and vice versa):

1. Gunnery officer.
2. Missile officer.
3. Ordnance officer.
4. ASW officer (except on an ASW carrier, where the ASW officer is in the operations department).
5. Nuclear weapons officer.
6. Commanding officer of a Marine detachment.
7. Senior aviator (in ships not having an air department).
8. OIC of the drone antisubmarine helicopter (DASH) detachment, when embarked.
9. Cargo officer.
10. Ship's boatswain.

Commanding Officer of Marine Detachment

The commanding officer of the ship's Marine detachment is not a department head. He has a somewhat similar position with respect to the administration of the Marines aboard in matters pertaining strictly to the Marine Corps. He is also one of the division officers of the weapons department, since the Marine detachment is a regular part of the ship's company.

The main functions of a Marine detachment aboard ship are to provide–

1. A unit organized, trained, and equipped for operations ashore, as part of the ship's landing force, as part of a landing force of Marines from ships of the fleet or a subdivision, or as an independent force for limited operations.
2. Additional gun crews.
3. Internal security for the ship.

The detachment forms a separate division that is employed as a whole in the battle organization. In battle, the detachment mans gunnery stations.

Engineer Officer

The functions of operation and maintenance of ship's machinery are assigned to the engineering department. Damage control and certain types of repair also are in the charge of various divisions that make up the department. Such divisions may be the auxiliary, repair, boiler, main engines, and electrical.

The head of the engineering department is designated the engineer officer. He is responsible for operation, care, and maintenance of all propulsion and auxiliary machinery, for control of damage, for operation and maintenance of electric power generators and distribution systems, and upon request from the head of a department, for accomplishment of repairs that are beyond the ability of repair personnel or equipment of other departments.

The engineer officer is responsible for operation of main engines and boilers. He ensures that boiler fires are not lighted or secured without permission from the captain (except in emergencies) and that main engines are not turned (fig. A-20) except by permission of the officer of the deck. He maintains the engineering log, engineer's bell book, and other engineering records.

As damage control officer, the engineer officer maintains an effective damage control organization. His responsibilities extend to the control of stability, list, and trim of the ship.

Assigned to the engineer officer may be a main propulsion assistant, a dmaage control

134.151
Figure A-20.—Engines may not be turned or speed altered unless directed or permitted by the conning officer. To increase speed, the throttleman (right) opens the throttle to admit more steam to the ahead turbines.

assistant, an electrical officer, a fire marshal, and special assistants for NBC defense.

Air Officer

In ships that have an air department, the head of that department is the air officer. He supervises and directs launching and landing operations and the servicing and handling of aircraft He is responsible for crash salvage operations and aircraft firefighting He is also responsible for aircraft handling equipment such as elevators, catapults, and arresting gear, and the care, stowage, and issue of aviation fuels and lubricants.

Assistants to the air officer may include a flight deck, catapult, arresting gear, hangar deck, aviation fuels, aviation ordnance, and aircraft handling officer.

Aircraft Intermediate Maintenance Officer

Aircraft maintenance functions are divided into three distinct levels, organizational, intermediate, and depot.

Organizational maintenance is performed by squadron or unit personnel on a day-to-day basis. It includes routine inspection, servicing, handling, and "on-aircraft" corrective maintenance such as removal and installation of parts and components.

Intermediate maintenance is shop-type repair and test work (e.g., minor modifications, defined periodic inspections, assembly, preservation) on aircraft components and equipment.

Depot maintenance includes overhaul, major repairs, and major changes. It is normally accomplished ashore.

Aboard carriers, the aircraft intermediate maintenance department (AIMD) is manned by permanently assigned personnel who normally are assisted by AIM personnel temporarily assigned from embarked squadrons.

The aircraft intermediate maintenance officer supervises and directs the intermediate maintenance work. When sufficient squadron maintenance personnel are embarked, the AIMD merely provides and maintains service and repair shop facilities for their use. When maintenance personnel are not embarked with the squadron, AIMD personnel also perform needed maintenance and repair functions.

Air Wing/Group Commander

The embarked air wing or (on a CVS) air group commander (or senior aviator in other air units) is the department head for the embarked squadrons. He directs training of the air wing/group. He coordinates all activities of the several squadrons and detachments in the execution of employment schedules. He also ensures the material readiness of the wing or group as a whole.

The wing/group commander maintains a continuing safety program in the air and on deck. He instructs embarked personnel on ship's organization, regulations, and procedures. He coordinates with the operations officer in matters concerning jobs scheduling, training, and tactical air operations.

Squadron commanders are assistants to the air wing/group commander.

Reactor Officer

Nuclear powered ships have a reactor department headed by a reactor officer. His basic job is the operation, care, and safety of the reactor plants and auxiliaries.

The reactor officer is a technical assistant to the commanding officer on matters involving reactor safety. He heads up the disposal of radioactive wastes from reactor plants. He is responsible for working of main engine throttles and maintains the engineer's bell book. He works closely with the engineering officer in the operation and maintenance of the propulsion plant.

When assigned, the reactor mechanical assistant and reactor control assistant report to the reactor officer.

Supply Officer

The supply officer heads the supply department. He is responsible for ordering, receiving, storing, issuing, shipping, selling, transferring, accounting for, and maintaining all stores and equipment of the command, except those assigned to other departments.

Specific functions of the supply department include receiving, delivering, and shipping medical and dental supplies and equipment; inspecting material received under orders and contracts that call for inspection and delivery; operation of the general mess; the preparation and service of food; operating the ship's store, which provides articles and services for the ship's crew, operation of the small stores unit, which makes available, for sale, uniform items, and upkeep of storeroom spaces and issue rooms.

Assistants to the supply officer may be an assistant for disbursing, a stores officer, a ship's store officer, and a food service officer. A mess deck master at arms, when assigned, assists the supply officer in such matters as the maintenance of good order connected with the general mess, cleanliness of messing area, and care and upkeep of messing equipment.

Medical Officer

The head of the medical department is the medical officer Usually he is the senior officer of the Medical Corps serving on board. He is directly responsible for the health of personnel of the command. He advises the commanding officer in matters of sanitation and hygiene.

The medical officer routinely inspects the ship's messing, food service, living, berthing, and working spaces to ensure sanitary conditions. He makes a weekly physical examination of food service personnel, barbers, and messmen. He heads up the training of personnel in personnel hygiene, first aid, and self-aid, artificial

respiration, and NBC warfare medical defense. He identifies and cares for the dead.

In ships having no medical officer attached, enlisted medical personnel are responsible directly to the commanding officer for medical matters. For military and administrative functions, they are assigned to the operations department.

In small ships the medical and dental departments may be combined, or they may be nonexistent.

Dental Officer

In ships that have a dental department the senior officer of the Dental Corps attached to the ship is the department head. He is responsible for the dental care and oral health of ship's personnel. The dental officer and his subordinates may, in emergency situations perform such duties for the care of the sick and wounded as the commanding officer may direct.

Repair Officer

Repair ships or tenders whose primary function is to repair other ships have a repair department headed by a repair officer.

Planning and scheduling are important details for the repair officer. He makes sure the work assigned to his department is completed as quickly as possible. Inspection of completed work is done to make sure that it is satisfactory. He makes and keeps a job order system as well as records of materials used and charges to be made. He prepares estimates of funds required for repairs furnished.

Like other department heads he is responsible for the training of his personnel. He also coordinates his department with others in the ship.

In submarine and destroyer tenders an additional department is established–the ordnance repair department. It is headed by the ordnance repair officer. His duties parallel those of repair officers but are concerned with submarine ordnance.

DIVISION OFFICERS

The departments of a ship are composed of divisions. The divisions are organized into watches, sections, or both. The division is the basic unit of men aboard ship. The number of divisions in a department varies between ships. Division manpower may be very small or include perhaps two hundred members. As far as practicable, divisions are assigned battle stations that permit their use as units under their own officers and petty officers.

A division officer is one assigned by the commanding officer to command a division. Division officers are responsible to department heads. They have a vital role in a ship's administrative organization.

The division officer is, above all, a guide, leader, counselor, and supervisor. He must show a very personal type of leadership. How he exerts that leadership can make or break his division. Particularly in a small ship, he is the enlisted man's major link in the chain of command. Whatever other duties he may have, the division officer must find time to exercise constant, direct supervision of and personal contact with his men.

The manner in which a division officer carries out the policies of his superiors sets the pace for his entire division. He is in such a position that almost every duty he performs produces instant results. He personally is responsible for seeing that a job gets done He cannot issue unclear instructions and leave the details to be done by others. How he gets the job done, how he gives orders, how he reacts to orders from above, his drive or lack of it–all these help the morale and spirit of the division. If he wants an alert division eager to follow his lead, he must set the example.

Personal leadership is important to the division officer. He has many direct contacts with the men, and must see to it that they perform all duties assigned. Especially in training his men is the division officer's leadership needed. His effectiveness is measured by the extent to which he fulfills his main duty preparation of his men for battle.

the men in his division. This is based on the ship's battle bill and the organization and regulations manual. It shows each man's name, rate, billet number, and bunk number. In addition, it shows for each man his battle station; his watches during Conditions 1, 2, and 3; his station or duty in the event of an emergency such as fire or man overboard; his at-sea and in-port watch station; and his cleaning station.

PART B

NAVAL HISTORY

In this section, you will learn what the conditions were in Europe that led to the discovery of America. You will be able to discuss the factors that enabled America to grow from tiny colonies to energetic and prosperous market cities involved in local and transoceanic trade and fishing. You will discover the role that America's natural resources, on land and sea, played in the rapid growth of the nation. You will discover the challenges that the new nation faced in the open seas. You will learn how America's conflict with England, France, and the Barbary pirates contributed to the establishment of a national Navy. You will appreciate the contributions which men like John Adams, Thomas Truxton, Joshua Humphreys, Edward Preble, and John Paul Jones made to America's growth as a nation. Finally, you will learn that the price of unpreparedness for war is a high price indeed. The text for this section is *American Maritime Heritage*

PART C

LEADERSHIP

This portion of the text is an Introduction to Leadership. It is desired that you develop a clear understanding of leadership and how it applies to the Navy. You will also study how human behavior is related to leadership, what motivates people, and how attitudes affect our daily lives.

STUDY SKILLS

LEARNING

We normally think of learning as an improvement of some kind. It is true that learning can result in improvement, but is can bring about undesirable changes too. The neglected child can learn to get attention by means of a temper tantrum, which is undesirable. The usual definition of learning is "a process which brings about a change in a person's way of thinking about, or responding to, the surrounding world." It differs from behavioral changes due to other influences, such as growing up, fatigue, or drugs. What actually takes place in our brains during learning is still something of a mystery. Individuals respond differently before and after learning It is also known that certain factors are important to complete the process of learning Some of these factors are related to the material to be learned and the way it is presented, while others deal with the learners and how they feel about learning. In particular, the attitude of the learner and their desire to learn (motivation) are of great importance.

ATTITUDE AND MOTIVATION

One may ask, "How is learning related to leadership?" When we examine leadership qualities later in this section, you will see that one important job of a leader is to promote proper attitude and motivation. The same characteristics are required for efficient learning. A teacher is a leader, who must inspire and motivate the students. Attitude is the way we feel about something. For example, we may like history but hate mathematics. Attiude is learned, and it can be changed. Developing a proper attitude is the key to success, whether it be in school, work, or the Navy. A proper attitude provides the motivation to study, learn, or do a job right. Motivation is the desire to move or act in a useful way.

In order to learn, you must be motivated, and the primary factor producing proper motivation is attitude. If you have trouble with motivation, evaluate your attitude. How do you feel about learning this particular material? Do you feel it is important to you? Do you like it? Is it necessary for your future plans? Your answer to these questions will often point out attitude problems. Talk them over with your teacher or your advisor. Often, attitude can point out things that you are not aware of Sometimes discussions can make the material more interesting to you.

STUDY SKILLS

Study skills are the methods by which we study. Some people are better at studying than others, just as some bricklayers or carpenters are better than others. But skills can be learned, whether they relate to bricklaying or studying. Many authors have written books on how to study properly and develop study skills. Here are some suggestions.

1. Eliminate distractions and concentrate. Be sure your study area has no television or distracting pictures. Try to maintain a quiet room with good lighting and a comfortable chair. Do not try to study while lying down.

2. Study as you listen in class. In order to do this, you must study ahead. Keep your lecture notes brief so you do not spend all your time taking notes with no time for learning. Make class notes a supplement to the text.
3. Keep your study materials and notes neat and well organized. This often helps when you must refer to notes taken some time ago.
4. If you are required to memorize material, do so a little at a time. Go slowly and surely. The best time for memorization is just before going to bed at night. Seeing something many times helps you to memorize it, so try writing it down.
5. Study as you read. It is recommended that you first read the table of contents and skim through the main headings to get an idea of what to expect. Then read the entire assignment rapidly, trying to find out the ideas expressed. Take notes on the main points if you wish, but at the end of each section recite what you have learned. Write it down if you find it helpful. If you have trouble with words you don't understand, look each one up in a dictionary on the first reading Then read the material again and recite what you have learned
6. Learn to manage your time. Do not put off studying until the last possible moment. Plan your studies, and then force yourself to sit down and "dig in". Make a schedule which allows time for study and time for recreation–then stick with it. Use rewards, such as movies, dates, etc., to follow periods of study.
7. Make resolutions on the way in which you approach learning. Some suggestions for such resolutions are.
   a) Make a plan for each course
   b) Learn as much as you can in each course, rather than just doing required assignments.
   c) Learn to read effectively for each course.
   d) Control your attention and try to do a careful, accurate job on examinations.
   e) Improve your listening skills.
   f) Review each course from the beginning every few days to keep the overall pattern clear in your mind.
   g) Begin preparation for examination in the first class meeting.
   h) Strive to improve your handwriting through practice.
   i) Keep a record of assignments and keep homework up to date.
   j) Set a high standard for homework.
   k) Analyze test papers, searching for the cause of any low grade.

You may find other ways to improve your study skills. Some of the suggestions above may be appropriate for you and some may not. You can be sure that they have worked for many people.

LEADERSHIP IN THE NAVY

WHAT IS LEADERSHIP

Before studying leadership, we should define it. This is not an easy task. It is not something tangible (something you can touch) like an apple or an orange It is a quality by which a person can direct the thoughts, plans, and actions of others. There are different levels of leadership Some people are very good leaders, others are fair leaders, and some have practically no leadership qualities. Why is this? What does your experience tell you about the true meaning of leadership?

In olden days, it was believed that a leader emerged because of having royal blood Heredity was thought to be the basis of leadership Today, we believe that leadership is an art and can be learned. We no longer believe that leaders are born–we believe that they are made People can be trained to be leaders. They may be elected, they may come to power through revolution, or they may be appointed. In any case, to be effective leaders in such positions they must develop the art of leadership.

Leadership has been defined as an art. An art is learned in a different way than other skills.

For example, playing the piano is an art. Learning an art requires practice. Only so much can be obtained from books or teachers. You can learn an art by teaching yourself through continued practice. You must teach yourself the art of leadership.

Leadership is learned through change of behavior. In fact, almost any learning can be described as a change in behavior. Before change can take place in a person's behavior and attitude, he must be motivated to change. The key to learning is motivation, the greatest single factor affecting learning. Before you can hope to motivate others, you must first succeed in motivating yourself. You must convince yourself of the reasons for becoming an effective leader.

LEADERSHIP AND THE NAVY

The Navy is an organization which has a single purpose: to defend our country and our way of life against those who would destroy it. This means that the Navy is a fighting organization. To be an effective fighting organization, the Navy must have discipline, and discipline is produced by leadership qualities in its men. The need to continue development of individuals with strong leadership qualities within the Navy is so important that the Secretary of the Navy has issued very strong guidance in this area. This is General Order 21, which is a command to those officers within the Navy who are responsible for the development of leadership. Read this order and become familiar with its contents.

GENERAL ORDER
NO. 21

NAVY DEPARTMENT
Washington, D.C., 1 May 1963

LEADERSHIP IN THE UNITED STATES
NAVY AND MARINE CORPS

Part I—Discussion

The United States Navy-Marine Corps records of victorious achievements on land, at sea, and in the air in peace and war have won for these services an honored position in our great nation. This heritage was passed on to us by our leaders, both officer and enlisted, whose outstanding examples of courage, integrity and devotion to duty are historically significant. They accomplished their missions successfully by high caliber leadership and personal example. The strength of our nation and of our services depends upon courageous, highly motivated and responsible individuals.

Part II—Objective

The objective of this general order is to achieve an ever-improving state of combat readiness by.

a. Emphasizing that successful leadership at all levels is based on personal example and moral responsibility.

b. Insuring that every man and woman are themselves examples of military ideals.

c. Requiring personal attention to and supervision of subordinates.

Part III–Action

1. The Chief of Naval Operations and the Commandant of the Marine Corps shall be directly responsible for maintaining optimum leadership standards. The Under Secretary of the Navy shall be responsible for the proper implementation of this order.

NOTE: This general order supersedes General Order No. 21 dated 17 May 1958 C.G.O. 9

General Order No. 21

2. Fleet, Force, Type and Administrative commanders shall review each command's leadership posture as an integral part of military inspections and shall include their evaluation in inspection reports.

3. Every command and every major office and bureau of the Navy Department shall, on a continuing basis, review its leadership standards; each shall take effective measures to improve them and shall develop an awareness of the need for good leadership by providing programs for instruction in leadership principles and practices.

4. All persons in responsible positions, military and civilian, shall require that their subordinates discharge their duties in accordance with traditional concepts of Navy and Marine Corps standards, paying particular attention to.

a. Moral responsibility.
(Article 0702A, *Navy Regulations* - Paragraph 5390, *Marine Corps Manual*)

b. Personal example of behavior and performance.
(Article 1210, *Navy Regulations* - Paragraph 5390, *Marine Corps Manual*)

c. Established standards for personnel development.
(Article 0710, *Navy Regulations* - Paragraph 1500, *Marine Corps Manual*)

d. Integration of principles and practices of leadership into everyday routine.
(Article 0709, *Navy Regulations* - Paragraph 5390, *Marine Corps Manual.*)

e. Effective organization and administration.
(Article 0704, *Navy Regulations* - Paragraph 3000, *Marine Corps Manual.*)

For emphasis and ready reference these articles are reprinted with this General Order.

/s/ Fred Korth
Fred Korth
SECRETARY OF THE NAVY

0702A. Commanders' Duties of Example and Correction

All commanding officers and others in authority in the naval service are required to show in themselves a good example of virtue, honor, patriotism, and subordination; to be vigilant in inspecting the conduct of all persons who are placed under their command; to guard against and suppress all dissolute and immoral practices, and to correct according to the laws and regulations of the Navy, all persons who are guilty of them, and to take all necessary and proper measures, under the laws, regulations, and customs of the naval service, to promote and safeguard the morale, the physical well-being, and the general welfare of the officers and enlisted persons under their command or charge.

1210. Conduct of Persons in the Naval Service.

All persons in the naval service shall show in themselves a good example of subordination, courage, zeal, sobriety, neatness, and attention to duty. They shall aid to the utmost of their ability, and to the extent of their authority, in maintaining good order and discipline, and in all that concerns the efficiency of the command.

0710. Training and Education.

The commanding officer shall

1. Endeavor to increase the specialized and general professional knowledge of the personnel under his command by the frequent conduct of drills, classes, and instruction, and by the utilization of appropriate fleet and service schools.

2. Encourage and provide assistance and facilities to the personnel under his command who seek to further their education in professional or other subjects.

3. Require those lieutenants (junior grade) and first lieutenants who have less than two years commissioned or warrant service, and all ensigns and second lieutenants

(a) To comply with the provisions prescribed for their instruction by the Chief of Naval Personnel, the Commandant of the Marine Corps, or the chiefs of other appropriate bureaus

(b) To keep journals, to attend classes, and to receive appropriate practical instruction, as the commanding officer deems advisable

4 Detail the officers referred to in paragraph 3 of this article to as many duties successively as practical. This rotation of duties should be completed during the first two years of the officer's commissioned service. The commanding officer shall indicate on the fitness report of each such officer the duties to which he has been assigned, the total period of assignment, and the degree of qualification in such duties.

5. Designate a senior officer or officers to act as advisors to the officers referred to in paragraph 3 of this article. These senior officers shall assist

such junior officers to a proper understanding of their responsibilities and duties, and shall endeavor to cultivate in them officer-like qualities, a sense of loyalty and honor, and an appreciation of naval customs and professional ethics.

0709. Welfare of Personnel.

The commanding officer shall:

1. Use all proper means to promote the morale, and to preserve the moral and spiritual well-being of the personnel under his command.

2. Endeavor to maintain a satisfactory state of health and physical fitness in the personnel under his command.

3. Afford an opportunity, with reasonable restrictions as to time and place, for the personnel under his command to make requests, reports or statements to him, and shall insure that they understand the procedures for making such requests, reports, or statements.

4. Insure that noteworthy performance of duty of personnel under his command receive timely and appropriate recognition and that suitable notations are entered in the official records of the individuals.

5. Insure that timely advancement in rating of enlisted personnel is effected in accordance with existing instructions.

0704. Effectiveness for Service

The commanding officer shall.

1. Exert every effort to maintain his command in a state of maximum effectiveness for war service consistent with the degree of readiness prescribed by proper authority.

2. Report to his appropriate senior any deficiency which appreciably lessens the effectiveness of the command.

3. Report, with his recommendations, to the bureau or office concerned, whenever, in his opinion, his authorized allowances of personnel or material exceed or fall short of requirements.

What do you think would happen in the Navy without the development of effective leaders? Remember that the Navy's purpose in peacetime is to be ready for war, in the hope that such preparedness will discourage a potential aggressor.

THE MEANING AND DEVELOPMENT OF LEADERSHIP

You can nearly always identify the leader in any group. In a work situation, it is the one who directs the efforts of others to get a particular

job done. If a leader gets the required work done with the support of the team members, good leadership is being demonstrated. The people have been motivated. If the "leader" cannot get the job done because of poor organization, inefficiency, or inability to motivate the people, this individual is clearly a poor leader.

To be effective, the leader must earn and maintain the confidence, respect, and cooperation. It has been said that a leader is known by the people he or she develops. Such leaders take an interest their people and guide them in such a way that the most is made of their talents, capabilities, and skills. They, in turn, are more responsive and increase their abilities to do the job. Do you think General Order 21 promotes these aspects of good leadership?

What are the qualities of leadership? How are we to know what practice is required to develop the art of leadership? How does a leader earn the respect, confidence, and cooperation of others? This is a large responsibility, but let us discuss a few characteristics that a leader must develop.

A leader must provide inspiration and motivation. These are two of the best tools of leadership. Inspiration has to do with the leader's ability to help subordinates "catch on to" the mission of the group and the plan of action for carrying out the mission. Those who are inspired in this way are motivated (that is, moved to act in a useful way) to carry out the mission and the plan.

A leader must have the highest degree of moral responsibility. This means having a good code of personal conduct Offering subordinates the best in personal example, the leader's thoughts, words, and actions are all based on high standards of personal honesty Superiors and subordinates know that they can count on such individuals.

A leader must use good management practices. This means knowing the assignment of the unit. It also means knowing one's own abilities, and those of the subordinates. Further, it means knowing how to organize one's personal actions and those of the subordinates in order to carry out the mission. The effective leader is also willing to make the necessary decisions. The efficient leader is willing to try new ways of doing things. Devotion to assigned duties is a requirement.

A leader must have courage. This is the quality that permits and encourages taking chances in carrying out tasks and in seeking full knowledge of the job from anyone, be it superior or subordinate. This also means that the leader has self-confidence, without being arrogant or overbearing. Courage in leadership requires that a person overcome the fear of failure, as well as fear of personal danger.

The leader must have concern for subordinates. This means always having personal concern for the needs, problems, and worries of the subordinates. It means demonstrating a responsibility for their welfare and being loyal to them, as well as to superiors

The leader must promote morale, or "esprit de corps", in the unit. When provided with good leadership, the members of the unit have pride in themselves, their unit, and their service. This spirit will show itself in the way they perform their job, their attitude toward the job and their leader, and their overall morale A leader must be dependable. This requires striving to be prompt and expecting the same of subordinates A leader must continuously set a good personal example Professional and personal life styles can be an inspiration to both peers and subordinates.

These are some of the more obvious qualities of leadership They are quite general and apply in both the military and civilian worlds Can you think of other qualities which a good leader should have?

APPROACHES TO LEADERSHIP

One can now ask the question, "How do I go about developing these qualities of leadership?" Those qualities which are personal traits can be practiced in or out of a leadership situation You can develop moral responsibility, courage, and concern for other people as part of your everday life. You will be a better person for it. But when dealing with subordinates, and creating esprit de corps, there are several approaches which might be used. Which approach is best depends on your subordinates and the particular task to be performed. The approach which works well when dealing with one set of people may not be appropriate for another set. The five basic

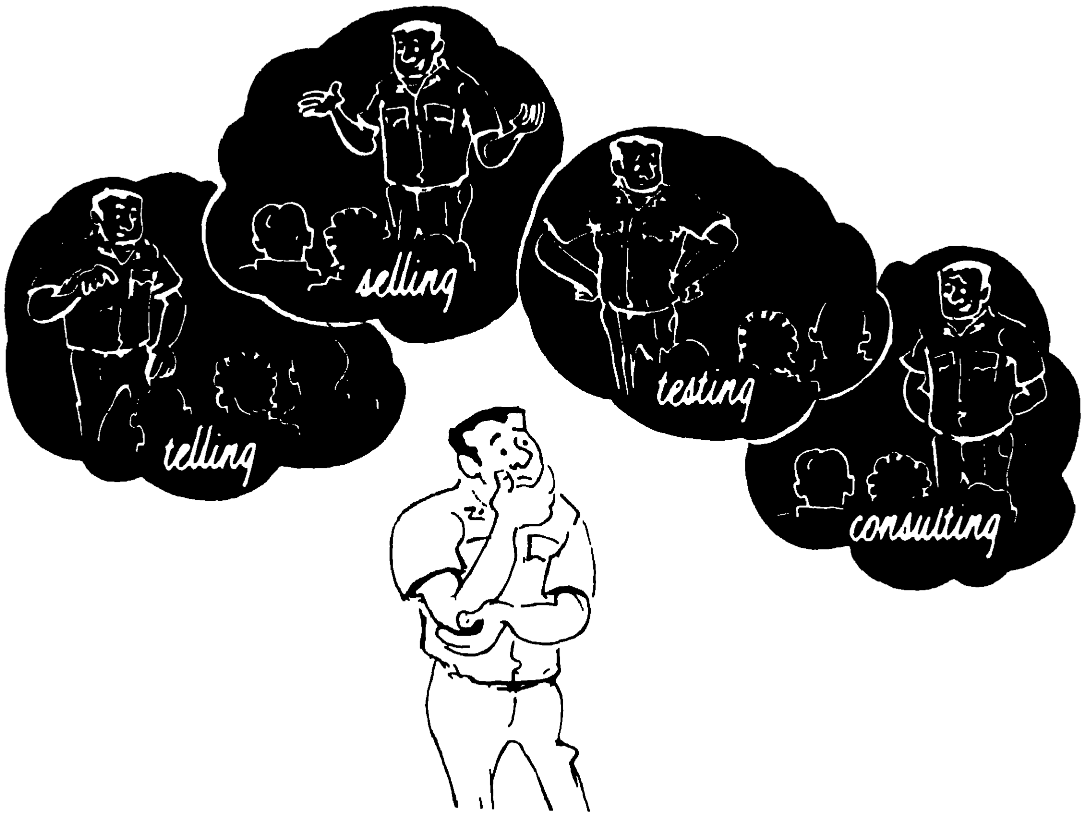

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Figure C-1.–Which approach is best for your group?

approaches are telling, selling, testing, consulting, and joining. Sometimes the proper approach to be used in any particular case is not obvious, as indicated by Figure C-1.

In the telling approach you retain all authority and give your group little freedom You decide and the group follows. You examine the problem, look at alternatives, choose the course of action, and then inform your subordinates of your decision. You consider the skills, knowledge, and attitudes of your group, but they do not participate in the decision making

In the selling approach you sell and your group accepts. You make the decision, and then sell your decision to your group by persuading them that the decision is "the best" for the group. You emphasize how the group will benefit from carrying out the decision.

191.29

Figure C-2.–The telling approach.

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Figure C-3.—The selling approach.

...u test, the group ... You identify the ... possible solution. You allow the group to react to it and accept suggestions. Then you make the final decision and inform the group.

131.31

Figure C-4.—The testing approach.

In the consulting approach, the group makes recommedations and you decide. You present the problem and ask for ideas from group members. Then you select the solution and inform the group of your decision.

In the joining approach, the group decides and you follow. Here the leader participates as

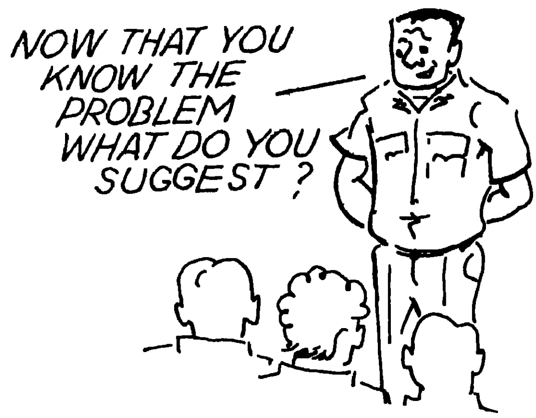

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Figure C-5.—The consulting approach.

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Figure C-6.—The joining approach.

"just another member" of the group. You agree in advance to carry out whatever decision the group makes. Note that the roles of leader and follower appear to be reversed.

What kind of leadership works best in a military organization? Which is best in a classroom? Can you think of any approaches other than the five mentioned above?

THE RESPONSIBILITIES OF LEADERSHIP

In the Navy, an officer or petty officer is appointed to be a leader. When a leader is made in this way, continuous effort to develop the qualities of good leadership are necessary. A leadership position normally involves management, which may require the learning of skills related to the management function. The leader is called upon to make decisions on matters which may affect subordinates, or perhaps the whole organization. Also, planning will be involved, sometimes relating only to the unit, but normally affecting the larger organization. The establishing of a working structure or organization within the unit will be an important concern Other responsibilities might be the coordination of efforts of various people or organizations, selection of staff members and assignment of personnel The leader will probably be involved in the evaluation of subordinates, recommendations of promotions or pay raises, and programs aimed at various goals, such as safety The leader is a manager, in addition to being a leader, in fulfilling his responsibilities of leadership

BEHAVORIAL SCIENCES

APPRECIATING THE BASIC NEEDS OF PEOPLE

Normally, people belong to a hierarchy of groups. This class is a group, but it is a part of a larger group, the sophomore class It, in turn, is part of the student body of your school. Each of these groups has goals and purposes. A leader's success depends to a great extent on relationship established with members of the group and the larger group. In a very direct way, followers can and do affect a leader's success in meeting his responsibilities. For this reason, a good leader takes into account the basic human needs of the followers.

People generally respond favorably to a leader who considers their basic needs. There is truth in the saying that, "You can catch more flies with honey than you can with vinegar." If people believe the leader is acting in a way that is helpful and supportive, their reaction will usually be favorable and responsive. This is called supportive leadership. Let us take a look at the basic human needs which the leader must recognize.

CLASSES OF HUMAN NEEDS

Each person is different from every other person. Although everyone has unique needs, there are many needs in common. People are subject to similar experiences in the family, their school, and society. Therefore, in spite of wide individual differences, people display certain common characteristics. Identifying and classifying the needs that influence human behavior are important leadership tools. To be a good leader, you should know and understand these needs.

People have five common needs. These needs may be pictured on a triangle, or pyramid, with the basic needs located at the bottom and the more complex needs at the top. Starting from the bottom, the needs arranged in order of their relative importance are (a) survival, (b) security, (c) social, (d) ego, and (e) growth This is indicated in figure C-7 Let us examine each of these needs separately.

The survival needs are related to physical survival They include such things as air, food, water, and shelter. They are basic needs and are placed at the first level because of their power to affect behavior. Suppose you were forced under water. Your need for air will compel you to the most violent physical efforts to return to the surface for air

A person who is an honest, law-abiding citizen would never steal. Suppose one could obtain no food for four or five days, and then had the opportunity to steal a loaf of bread. What do you think would happen? When the survival needs are not satisified, they cause a

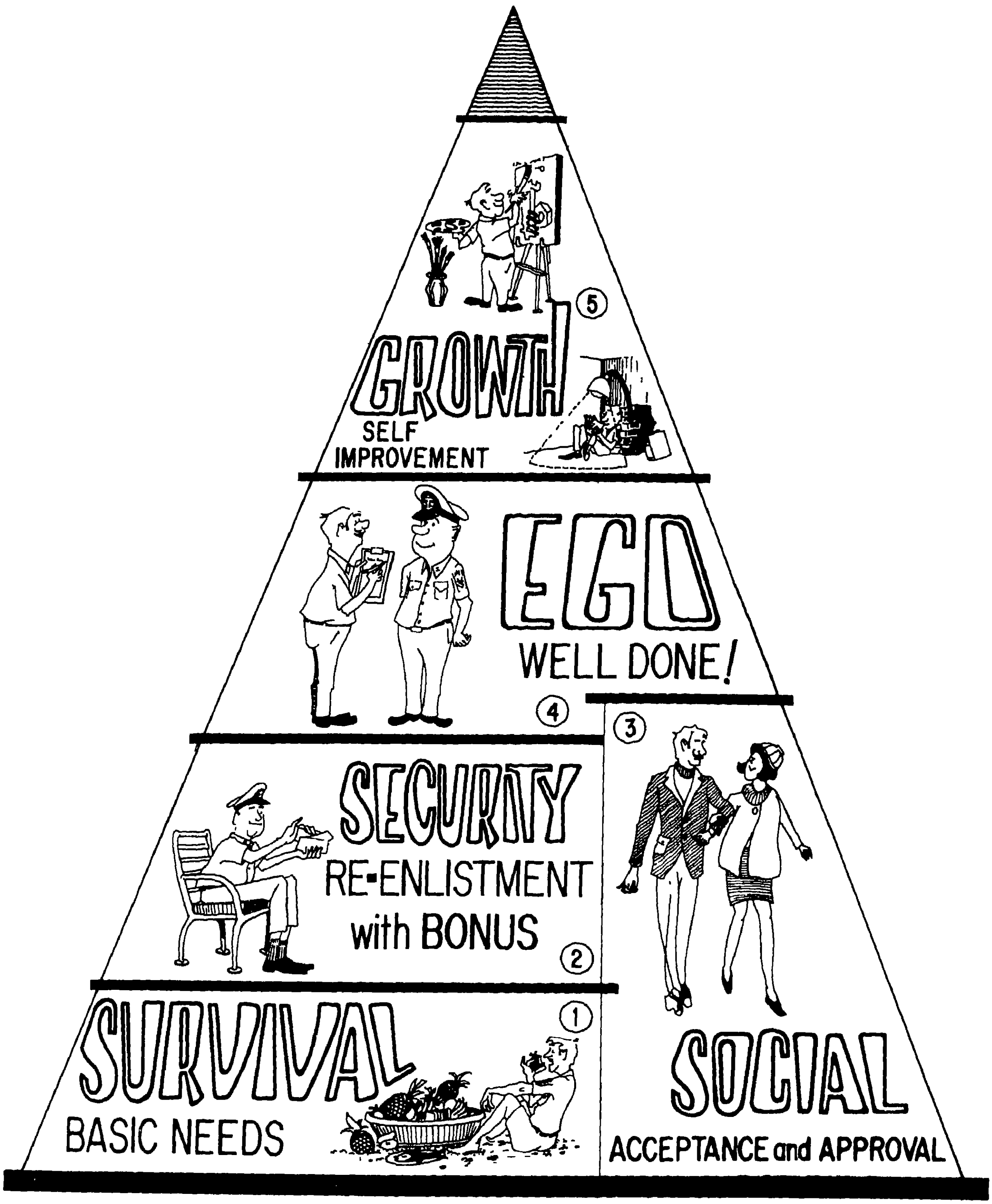

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Figure C-7.—Human needs.

person to go to great extremes to meet them. When such needs are felt, they motivate more strongly than any other type of need.

The extreme importance of survival needs is not evident in the day-to-day life of the average Navy man or woman. Usually they have these needs satisfied in the course of routine duty because they are rarely exposed to prolonged hunger or thirst. But if such needs go unsatisfied over a long period of time and threaten one's survival, their importance becomes obvious. Attempts to satisfy them will completely dominate behavior and mobilize all the capacities and energy that a human being possesses.

The emergency picture is not a typical one, but it illustrates the point that of all human goals and desires, survival is the most important. Once the physical needs for survival are satisfied, they no longer dominate behavior. Other needs then influence our behavior

The security needs come into play when we have met most of our physical needs. When we are no longer worried about today's needs, we become concerned about tomorrow's breakfast or next winter's shelter. However, the average Navy person in ordinary times is not too concerned with these security needs. The Navy takes steps to provide protection from extreme forms of violence, disease, famine, and poverty. The sense of security in a smooth-running unit is usually taken for granted. A Navy member expresses security needs in the desire for a stable assignment, for safe working conditions, for money in the bank, and for consistent leadership.

Security needs are closely related to an orderly, stable, predictable environment, in which unexpected, unmanageable, and dangerous events seldom happen. The familiar is preferred to the unfamiliar, the known to the unknown. Security needs usually do not operate unless one is threatened or endangered. Panic can result from the attempts of many people to satisfy their security needs at the same time, which might happen in the case of a fire in a crowded area. Except in such crisis or emergencies, the normal person is more concerned with satisfying other needs.

Some people never get beyond the level of satisfying security needs. Anything new is dangerous; any change in the routine means a step into the dangerous unknown. They tend to subdue everything else in life to their need for security.

If both the survival and the security needs are adequately satisfied, then the social needs emerge. This is a broad term for love, acceptance, and approval by others. At this stage, a person feels keenly the absence or lack of friends and seeks friendly relations with people in general. We desire to be liked and wanted as persons. We want to belong.

There are two aspects to the social needs. The first involves love and affection between individuals, as expressed between sweethearts, husband and wife, parents and children, and very close friends. It is the intimate sharing of life with another or others. The second aspect of social needs makes us want a stable, accepted relationship with other people. This occurs when we become a functioning member of a group. This covers all the formal and informal groups of people with whom we work, live, and play. We tend to identify ourselves with particular groups and to seek acceptance from them. We often change our behavior to meet the standards of the group.

The social needs revolve around one central idea the need to be liked and wanted, not only by our intimate family and friends, but by the people with whom we associate in work or play In the Navy, the group concept—that is, two or more people doing a job together—can become the means of satisfying the needs for acceptance and belonging The group concept rising from the need to belong is an important consideration for effective leadership

All the needs that make us feel more important fall within the category of ego needs In this area of increasingly complex higher needs, it is more difficult to make exact distinctions. It is almost impossible to isolate one single need from the others. The need to belong and to be identified with a group is just a short step from the need for status and recognition by the group. The former implies passive acceptance of us as a person by others; the latter involves not only

acceptance but active recognition of our talents and abilities

Whether it's winning a contest or repairing a jet engine, there is a basic satisfaction for all of us in achieving or doing a job well. We are pleased if other people recognize our achievements and applaud our efforts. Most people want recognition for their efforts. The approval of an audience often stimulates them to do their best work. Doing any job well can be a powerful motivator for the person who seeks status and recognition.

We tend to have a mental picture of ourselves. This self-image demands that we do certain things or move in certain directions to maintain self-respect. Depending on the circumstances, we can see ourselves in different roles and act consistently with them To fellow clerks, one may be a whiz with figures; to superiors, a model of exactness, to friends a good bowler; whereas for the sweetheart, the most charming person in the world. Our ability to successfully act in many roles to our own satisfaction is essential to self-respect

There are two sides to ego needs, the need for status and recognition by others and the need to maintain self-respect with all the social and moral standards that are involved Satisfaction of the ego needs leads to feelings of self-confidence, worth, strength, capability, and adequacy. These develop a person's sense of being useful and necessary.

Because of individual differences, the desire to satisfy the need for esteem may result in varying forms of behavior. A scientist, for example, who is primarily motivated by needs for prestige in scientific or academic circles may be warm, likeable, and sociable. Another scientist may be cold, unpleasant, and hermit-like, and depend solely on the recognition of research to satisfy ego needs.

Even when people have satisfied most of their ego needs, they seem to feel the urge to move on to a higher level. At this level one approaches the fullest possible integration of talents, capacities, and potentials. Such desires to combine and make the best use of these attributes may be demonstrated by yearnings to be a Navy flier, an Olympic champion, or to reach some other goal or attainment. In any case, moving toward the highest development of which one is capable, is the force motivating the behavior. An inner need to grow and to be unique is the individuals ambition. Such people are not as dependent on the outer world of people and things for the satisfaction of needs as they are upon their own sense of accomplishment.

Self-fulfillment (sometimes called self-actualization) should not be confused with outstanding achievement, which may exist on the level of ego needs. Nor should it be equated with high intelligence or great ambition. The average person has as much need and capacity for self-fulfillment as does the outstanding leader in any field.

On the scale of needs, self-growth comes at the top. In general, all the other needs must be adequately satisfied before the need to develop one's full potential and talents becomes a strong influence on behavior. Most people must satisfy their basic needs for survival, security, social belonging, and self-esteem before they can fully use and develop their talents, capabilities, and potential.

BEHAVIOR IS DIRECED TO ACHIEVE A GOAL

Human behavior can be explained to a large degree by the needs people have The general notion is that people do things because they have specific needs that they seek to satisfy For example, a person seeks food because of a need for food or seeks success because of a need for approval or power.

Needs are driving forces of life. They energize behavior. A need is a type of tension which influences a person's behavior

We can think of human behavior as a person's constant attempts to reduce tensions—to get needs satisfied To satisfy needs, we direct our behavior toward a goal that is tension-reducing. For example, you need money to buy an automobile, so you direct your behavior (working, for instance) to achieve your goal (obtaining a car).

Tensions vary in type and strength with the particular situation. Hunger is a tension. Your stomach muscles actually contract to produce that hungry feeling. After you start eating, the

tension gradually disappears and the hunger goes away.

Suppose you are thirsty. Drinking a glass of water is an appropriate action to satisfy your need for liquid. If you are not very thirsty, you probably would not mind too much if water is not readily available. But if you are really thirsty, you begin to concentrate on finding water or liquid, almost to the exclusion of everything else. One thirsting for days in the desert begins to think of nothing but water; everything done is motivated by this need for water.

Some of the characteristics of human behavior now begin to come clear. It is caused by a need or tension that is unfulfilled. This need puts into action the energy required for reaching a goal that will satisfy the need and reduce the tension. If one solution fails, we try another, mobilizing more and more energy as the need becomes more intense. Gradually, everything that does not help us reach the goal is excluded.

In general, human behavior follows this pattern

1. Behavior is caused by a need which mobilizes the energy necessary to reach a satisfactory goal.
2. As the need becomes more intense, efforts to achieve the goal become more vigorous.
3. With increased intensity of need, behavior is narrowed down to those actions which are more promising as far as the goal is concerned.

For our more complicated needs, such as self-fulfillment, satisfactory ways to fulfill them may be more difficult to achieve We may try some misguided ways, such as bragging a lot to show that we are superior to other people. However, a wise person eventually finds that the most positive and successful way to be somebody is to do the work well and gain the respect and acceptance of fellow workers. This way of satisfying needs is a better way of reducing tension and is more rewarding.

BEHAVIOR IS COMPLEX

Needs seldom work one by one. In an individual's behavior, many needs are at work over a long period of time. Rarely can we account for a person's actions by naming a single need. The behavior of a person who is hungry, interested in company, and also anxious for status improvement, will probably seek a way of behaving that will satisfy all these needs at once. Sometimes it is impossible to find any such adjustment.

Often we cannot fully identify the needs that drive us forward. We say we want a new car to save on repair bills and depreciation. We are not likely to admit that we desire a new car to impress our neighbors and friends. Some of the drives that direct our behavior are in our subconscious mind. We become highly selective in being conscious of those needs that are most important and acceptable to us. In the same way, we tend to judge outside actions in terms of what is most comforting or of value to us. We direct our behavior to protect inner feeling of importance, and try to avoid situations that we feel would be painful, punishing, or threatening to our feelings of esteem. Our behavior is protective and defensive against threats such as another person's disapproval, censure, or dislike. One's needs are to maintain mental and emotional well-being, as well as physical health.

With these points in mind, we can view complex behavior as the result of many similar and conflicting needs operating at the same time and interacting with each other. We cannot see or measure a need. We infer what is happening from observations of a person's behavior. We know that when we experience a need we attempt to satisfy it. We are aroused to action, and there must be energy mobilized for this action. Ordinarily, we know what will satisfy us. Furthermore, the longer the need is unsatisfied, the more important the goal usually becomes. The goals of behavior may be generated either by conscious and/or subconscious needs. Survival needs may arise singly. We are hungry or thirsty or tired at separate times. In contrast, the more complicated needs rarely, if ever, work one at a time Ordinarily, a wide range of needs operate at the same time.

Complex behavior is variable and persistent. It is often influenced by habits, cultural patterns and individual differences. We seek a satisfactory way of behaving that can be applied in many situations. Normally, we are not continually facing situations where we have to work out a completely new way of behaving. Our attitudes, values, interests, standards, and habits interact together to form a general pattern of how we shall act in most given situations. These are our basic tools for successful living in a complex society. Ways of behaving vary from one individual to another.

Finally, it is part of our dignity to place limitations on behavior. We can postpone immediate satisfaction for long-term satisfaction. We can accept a stirred-up state of present discomfort in hopes of future gains. To obtain ultimate relief from pain, one will take medicine that momentarily is distasteful. People endure present hardships and deprivations if they see it leading to a future good that outweighs present disadvantage. A parent may do without many conveniences to provide a son or daughter a college education. Future satisfaction is worth the price paid today

Much of our behavior involves a choice, a weighing of the pros and cons of immediate satisfaction against future benefits. Often we make a choice for the present, with bad results, sometimes we postpone the present benefits hoping for future satisfaction

WHY HUMAN BEHAVIOR DIFFERS

A Person's Culture Influences Behavior

Each individual is born into a culture The people in this culture have certain established ways of going about life. They have definite notions about morality They possess established habits of work, play, cleanliness, and eating Certain institutions of worship and government are developed to meet common problems and needs. Values, assumptions, morals, customs, and institutions vary tremendously from one culture to another. The social climate in New Guinea is not the same as in Tokyo, Kalamazoo, New Delhi, or Washington.

Individuals are always trying to adjust to the culture in which they are born, growing and functioning. The process of making this adjustment with the environment is largely a process of learning the "right" needs.

The cultural pattern into which a person is born has a large influence on his physiological needs for food, water, rest, and sleep. A person eats to survive, but the questions of what sort of food, when, and under what circumstances can only be answered if we know about the eating habits the individual has learned while living in a particular culture. The individual's physiological needs are timed and trained by the daily routine of one's family, nation, and culture.

The influence of a person's culture is just as great on the needs people learn. Culture determines the needs themselves and also teaches the individual how, when, and where to let the needs operate.

An example is the desire to assert oneself, to obtain standing and position. In America, we regard this need as a basic part of human nature A major characteristic of Americans is the need for status, achievement, and superiority, but Americans were not created with this characteristic. They learned it In contrast, the Zuni of New Mexico do not like individual superiority The best thing they can say about individuals is that nobody every hears anything about them. Competition is practically unknown.

In our culture, self-assertiveness is a general need. Our culture has fairly definite rules about what "success" or "superiority" is and the means by which to achieve it The individual in our culture who has the Zuni's outlook on superiority would be considered strange

A Person's Immediate Situation Influences Behavior

Outside forces, such as conditions in the environment, influence the needs of people. In wartime, for example, a combat sailor's most important need is for survival. His basic physiological needs come first In times of depression, a job to provide life's basic necessities is the greatest need of many people. When one is reasonably certain of holding a job

that pays enough to provide food and shelter needed by the individuals or the family, need-satisfaction often shifts from these needs to other needs. Planning a vacation with family or friends may becomes important. Survival needs are still present, but a person's attention has turned to other needs upon the satisfaction of the survival needs.

Individual Differences Influence Behavior

People differ widely in their needs even though they grow up in the same culture and belong to the same social group. Though we generalize about the needs of the American culture, we still need to consider the unique individuals involved.

As a leader, you should view each person as an individual. When a new person is assigned to your unit, you are naturally interested in finding out something about that person. So, you review the personnel record and find that this person is (a) American (b) of Swedish ancestry (c) a high school graduate, and (d) was born on a farm in Iowa. These are the facts in the record but what do you know about this individuals needs? You know that there are the needs for food, air, water, as there are with other human beings. You can guess that there will be an interest in money, in success, and in having a few friends. But will there be a disciplinary problem? How about ambition? How about getting along with others? Will there be fighting at the drop of a hat? You do not know much about these things until you study the individual.

No two individuals are identical. Identical twins even have differences. Environments for any two individuals also varies The environment may seem identical to outsiders, but it is not the same to the people involved. The environment a person lives in is the environment as it appears to each individual, depending on unique hereditary and previous experience factors.

The following illustration from Sinclair Lewis' "Work Of Art" tells how two brothers reacted to the same family environment.

"My father," said Ora, "was a sloppy, lazy booze-hoisting old bum, and my mother didn't know much besides cooking, and she was too busy to give me much attention, and the kids I knew were a bunch of foul-mouthed loafers that used to hang around the hoboes up near the water tank, and I never had a chance to get any formal schooling, and I got thrown on my own as just a brat. So naturally I've become a sort of vagabond that can't be bored by thinking about his 'debts' to a lot of little shop-keeping lice, and I supposed I'm inclined to be lazy, and not too scrupulous about the dames and the liquor. But my early rearing did have one swell result. Brought up so unconventionally, I'll always be an Anti-Puritan. I'll never deny the joys of the flesh. . ."

"Andy, my father," said Myron, "was pretty easy-going and always did like drinking and swapping stories with the boys, and my mother was hard-driven taking care of us, and I heard a lot of filth from the hoboes up near the water tank. Maybe just sort of as a reaction I've become almost too much of a crank about paying debts, and fussing over my work, and being scared of liquor and women. But my rearing did have one swell result. Just by way of contrast, it made me a good, sound, old-fashioned New England Puritan."

Individuals in the same culture, even in the same family, differ enormously in the strength and variety of their needs. One may have a constant, burning desire to increase status. The need to get ahead will be the greatest need for this person, influencing all activities. It determines who the friends will be, whom to marry, how much effort is displayed and relations with superiors and subordinates. Another person may have such a strong need for sociability that friends are more important than "success". To this individual "getting ahead" is relatively unimportant. One person needs food more often and in greater quantities than does another. One person spends a lifetime seeking economic security, while another hunts for adventure and variety.

TENSION

It has been said previously that a human need is a type of tension a person has We have learned to think of behavior as attempts to reduce tension. But what do we mean by tension? In its most basic definition, tension is nervous and mental strain. Its causes are many, such as basic human needs which are not satisfied. Many of the psychological causes of tension begin in early life. Each person must

learn to adjust to the family circle. There must be adapation to the demands of group living as part of our society. One must live by the rules of society, accept responsibility, face competition, and achieve security in a world of change. In this process, we encounter many situtations which have a lasting effect and tend to produce tension right away or in later life.

In some people, tension builds to greater heights than in others. This quite often is due to the way in which these people think they fit into society as a whole, or into their particular group. Today, many people leave the areas in which they grew up and move to other places in search of opportunity. They lose the feeling of being "at home". They have a sense of being strangers, and this produces tension. But this is due only to the way in which they view their new environment. They can make new friends and become familar with the new area until they again feel "at home".

The driving need for success, the fear of failure, and the fight to "keep up with the Joneses" sometimes causes tension. Some people also tend to take on more work or responsibility than they can handle. In this way, they place themselves in tension situations. Often, tension is a temporary result of a particular situation. A family fight, a money probelm, girl-friend or boy-friend trouble, or a bad test grade may produce tension for a short while. Such tension can be quite severe, but it usually does not last

Dealing With Tension

The natural release for tension is action. "Doing something" is the way in which our body and mind best relieves itself of tension This may not come easy to some people Instead of taking action, they tend to turn inward. They hold back their emotions and brood. This in turn increases the tension by making the original problem seem even bigger than it really is Some doctors believe that this kind of tension can cause all sorts of physical problems. Headaches, stiff muscles, ulcers, high-blood pressure, heart trouble—all of these have been shown to be related to tension.

In many cases, a person can relieve tensions by talking about them. There is some basis for the old belief that "a good argument clears the air". But to "talk out" tensions need not mean an angry conversation. If the fears and annoyances that cause tension are openly discussed with a friend, emotions can be released and seen more clearly. Sometimes it is best to talk with someone outside of the family or circle of friends. It is often helpful to talk with a minister or the family doctor.

A person should avoid brooding about problems. Involvement in other things is often very helpful. Going to a movie, playing basketball, calling a friend on the phone—all of these can help keep a person from brooding.

When tension becomes so much of a problem that it interferes with everyday activities, then help from a doctor should be obtained. There is medication which can relax persons so they can see the causes of their tensions more clearly. While not "curing" tension, it may help the person to recognize the underlying causes.

Is Tension Necessarily Unhealthy?

In the above discussion, tension is presented as something which is a problem. And it is in the way it is described above. Yet, tension is a part of our everyday life. Isn't a basic human need a form of tension? Isn't it tension which drives us to eat when we are hungry, drink when we are thirsty, strive to do our best in competition, and grow and develop in our approach to life? What would the human race be like without tension of this kind? Tension is a normal part of our human nature. It is only when we cannot cope with the tensions of life that they become a danger to our mental and physical health.

FRUSTRATION

Frustration is a term used to describe the feeling when human needs and goals are not satisfied over a long period of time. Human behavior is a person's attempts to satisfy needs, while adjustment is the action taken when a need cannot be satisfied. Human adjustment is a never-ending process of dealing with frustration. Frustration of survival needs (food, shelter, sleep, etc.) are rare in our society. Today we have the higher level needs which may lead to

frustration. The security, ego, growth, and social needs are the basic human needs which lead to frustration if not satisfied. In our everyday life, we face one minor frustration after another. Can you name some of them?

ADJUSTMENT

The process of eliminating the tension produced by frustration is called adjustment. Since frustration means that the need cannot be satisfied, we work on changing the need or reducing the tension by some other means. Reaction to frustration usually falls into one of three general types. These are escape, neurosis, and good mental hygiene.

Escape refers to the various ways in which a person may try to keep from facing problems. Spending all your spare time watching movies or reading books may be an escape. The impulse to get drunk and bury your sorrows in alcohol or other drugs is a form of escape. Almost any attempt to "get away from it all" falls into this category. Jumping into a car and hitting the highway at top speed is a common American escape mechanism.

Neurosis refers to emotional problems. Just about any change from our normal behavior caused by tension falls into this category Some kinds of neurosis may not be much of a problem in everyday life. Others may present quite a problem. The forms of neurosis can range from a simple habit, such as biting fingernails, to severe mental problems. Stuttering and stammering may be a form of neurosis Absent-mindedness, moodiness, over-indulgence, and hostility are other characteristics which may be forms of neurosis. In modern terms, a neurosis is a "hang-up" of some kind.

The last form, good mental hygiene, occurs when a person adjusts to a frustration in a rational, logical way. The emphasis is to find a solution to the problem, not to bury it under a blanket of escape or neurosis. To develop good mental hygiene, we must train just as the athlete trains. In learning to face emotional tension, we cannot wait for a situation to arise and then begin worrying about handling the tension it produces. We must live the kind of life required every day. We must practice attitudes and test ourselves on small daily tensions. We must develop a personal code of conduct. Does this sound like leadership training?

Sometimes we are the cause of our own tensions. Knowing our own capabilities and limitations may help us in facing grave situations. Many times a person expects too much of self. The goals which have been set cannot be met, and then frustration develops. A person cannot fool self or others forever. On the other hand, many of us underestimate our own abilities. We are too quick to say "I can't", often for fear of failure. Learn your abilities and use them. Know your limitations and avoid situations which you cannot handle. Accept yourself for what you are and do the best with that. It will be a full-time job.

When a trying situation arises, face it squarely. Take a good look, get the facts. And then do something. Take action or make a decision. Endless waiting increases tension. At least getting started in your efforts to change the situation almost always reduces the tension it produces. Most people have some contribution to make in any given situation. Having faced yourself and having faced the situation, you will be ready to make a decision or take action. You do not have to solve the entire problem at once, but getting started on it sure helps.

These are just some ways in which you can develop good mental hygiene. You should develop your own personal code of conduct and live your life every day by this code. Face small problems in an effective way, and you can face larger ones the same way Practice on the small problems and it will train you to face the larger ones.

PART D

HEALTH EDUCATION

The greatest and mightiest ships ever built will be ineffective unless run by those who are healthy and of sound mind. In this part, you will learn the importance of physical and mental health. You will study personal hygiene and how humans develop and mature. Information about marijuana, LSD, and alcohol and the dangers associated with their use will be presented. You will study how these drugs may cause dependence and addiction.

Most of the study materials for this part will be found in this text. Material on personal hygiene will be found in Chapter 19 of *Basic Military Requirements*, NAVEDTRA 10054-D.

HUMAN GROWTH AND DEVELOPMENT

Growth is the progressive development of a living thing. Human growth is the process through which our bodies and minds develop. A person has matured, or reached maturity, whenever this development has been completed.

Human growth from birth to maturity involves many changes in body size and appearance, as well as changes in the way we think. This growth process in humans is not steady. At some times growth occurs rapidly; at others it progresses more slowly. These growth periods are different for different people, but everyone shows the same overall pattern. Individual growth patterns vary because of heredity and environment. Heredity is the inheritance of certain traits from our parents, while environment refers to the influence which the world around us has upon the development of our body and mind. Because of heredity, children tend to have physical characteristics much like their parents and grandparents. The environment may tend to alter these characteristics. Living conditions, including nutrition and hygiene, are an important part of the environment. They have a very large influence on growth and development An example of this is the long term trend over the centuries towards greater physical size, which is thought to be due to improved living conditions.

Growth in the human body is controlled by the endocrine glands. These glands produce hormones which regulate certain body processes The pituitary gland is an endocrine gland which produces a special hormone that determines body growth, particularly growth of the skeleton. This gland influences the size to which a person will grow. The growth hormone produced by the pituitary gland also affects the metabolism rate. Metabolism is the process by which the body uses food to produce energy and create new tissue.

The pituitary gland also plays an important part in regulating the other endocrine glands. These other glands control many functions by producing hormones that directly regulate metabolism.

The rate of growth differs a great deal from person to person. One child may grow very fast at a certain age, while another may not. This variation in growth rates may sometimes cause concern or worry. What we call "normal" is really only an average growth rate. This wide range of growth rates is usually quite normal.

In general, children have two periods of rapid growth. One of these is immediately after birth. The other is near puberty when sexual development begins In the first year, the average baby grows about 50 percent in size, and weight triples After this, growth rate slows until puberty. Puberty occurs at 9-13 years of age in girls, and 11-15 years in boys. With puberty comes another spurt of rapid growth. During the first nine or ten years, boys tend to be slightly taller and heavier than girls. Near the ninth year, girls briefly take the lead in growth. As the boy enters puberty at approximately age 13 his growth rate increases faster than the girl's.

During the rapid growth which occurs at puberty, sexual differences become apparent. The average girl will reach her adult size at the age of 17, while the average boy does so at 18 or 19.

The fact that different people grow at different rates makes it hard to predict the size a child will grow to as an adult. It is estimated

that the adult height will be about twice that reached at age two. Usually, girls will reach 52 percent and boys 48.5 percent of their final height at two years of age. The average boy who is three feet tall at two years will attain an adult height of six feet.

The whole process of growing up is called maturation. There are two general kinds of maturity: Physical and emotional. The growth process described above is called physical maturity. Indications of physical maturity are easy to observe and measure. When the soft areas at the ends of the bones become hard, the person is fully grown so far as height is concerned. For many people, there is still a process of "filling out". This refers to the development of muscle and other tissue. Physical maturation involves the appearance and body shape of the adult male or female and the ability to produce offspring.

The second kind of maturity is emotional maturity. It is an important part of the overall maturation process. It is difficult to measure emotional maturity, because of the variations among persons. There are no signs such as bone growth to indicate emotional maturity. Most psychologists agree that emotionally mature persons have reached a healthy balance between their own desires as persons and their responsibilities to society.

Emotional growth is related to physical growth, but many other factors are involved. Most of these are determined by the person's environment. Such things as family and community life, schooling, and the time at which a person begins to earn his own living, are important. For each person, the environment produces different patterns of emotional growth. Individuals may grow up physically much sooner than they mature emotionally. This is true for many young people in modern society. We do not ask them to be adults at a time when their bodies are fully developed. This leads to a lack of understanding between the young person and the adult. However, persons of 16 years can be very mature emotionally if circumstances have forced them to take on the responsibilities of adults. On the other hand, persons of similar age can be very immature emotionally, even though they may be very near physical maturity.

For some men and women, the pressures of life's problems may prevent them from ever reaching emotional maturity. Life in the adult world produces problems which they cannot resolve by themselves. They are forced to seek help from doctors or counselors who specialize in this kind of work. But for most people, emotional maturity develops when they leave the protection of home and school and move on to their life's work. They have families of their own and become productive members of society.

An important factor in developing emotional maturity is family understanding. Emotional problems do not happen all of a sudden. They can often be traced back to a person's early childhood. The experiences of the first weeks and months of a baby's life are important to later emotional growth. The personalities and attitudes of parents are particularly important. Growing children need healthy and happy home lives. They need to participate in the family life and discuss problems freely. Relationships with other children are also important. When children become teenagers, family relations change and hard feelings sometimes develop. Teenagers have a drive toward independence, which is perfectly natural. At the same time, they look to parents for support and advice. If parents fail to understand this need for independence, trouble may develop. If they fail to give emotional support, these young persons may feel no one cares for them. It is a difficult time for parents too. They must encourage the young persons to assume responsibility But at the same time, parents should not force them into situations for which they are not yet ready.

ENVIRONMENT AND HEREDITY

We have seen that the maturation process is due to heredity and influenced by our environment. The end product of the maturation process is the human adult. All adults have the same general appearance, but no two individuals are exactly alike. This variation, both physical and emotional, is produced by interaction between environment and heredity.

Environment is a very general term. Basically, it is the entire external world as it affects the functioning of our body and mind.

Environment includes other people, such as family, friends, teachers, employers, celebrities, and heros. It also includes animals, such as pets to which we become attached. Environment includes our neighborhoods, schools, the police, and the church. It is the food we eat, the air we breathe, the water we drink, the medical care we receive. Environment is the work, the play, and the exercise we become involved in. Environment is also the things we need and may not receive, such as nutrition, medical care, or a good family life. All of these affect the way we mature, both physically and mentally.

Heredity is the transmission of traits from parents to offspring. These traits are transmitted from each parent by structures called chromosomes. A chromosome consists of many genes. Each gene determines a specific hereditary trait. Half the genes are received from each parent, so the child will develop characteristics of both parents.

A great deal is known about the inheritance of traits in certain plants and animals. There is less known about human heredity. In a few months, many generations of flies can be studied to see how traits are transmitted from parent to offspring. In addition plants and animals can breed under controlled test conditions.

Probably the greatest difficulty in studying human heredity is knowing what is caused by heredity and what is caused by the environment. Although we have all the heredity factors from the beginning of life, the environment begins to influence the development of these factors immediately. Thus, we are the product of both heredity and environment.

There are certain things we do know about human heredity. In general, a child receives a set of genes from his/her parents These genes develop traits which relect those of parents, grandparents, or other ancestors. Before birth, these inherited traits are influenced by conditions within the mother's body. After birth, the traits are shaped by the environment. Much information has been obtained from studies of identical twins. Identical twins have identical sets of genes and thus the same heredity. If they are separted early in life, the differences developed are caused by the different environments.

THE FAMILY'S ROLE IN GOOD HEALTH

We have seen how important the environment is in the maturation process of a human being. One of the most important environmental factors is a child's family life. In fact, in early years, before the child starts to school, family life is practically the entire environment. It is during this time that the child should learn the basic practices of good hygiene and health care. It is also extremely important from the viewpoint of mental health. Family problems can have a very great effect upon the emotional development of a child. This can lead to emotional problems as an adult.

Hygiene is the science dealing with health and its preservation. It is concerned with actions affecting both physical and mental health. Personal hygiene involves many things, such as personal cleanliness, clothing, diet, sleep, work, exercise, and emotional attitudes. It is important that every person develop habits of good personal hygiene. It is in the family group that these habits are developed. The child learns by observing the parents, brothers and sisters. If good personal hygiene is practiced by members of the family unit, the child will develop long-lasting attitudes which permit maturing into a healthier, happier adult

SENSIBLE DRIVING

One of the fastest ways to ruin your health is to have an accident. A perfectly happy healthy person at one instant can become a helpless cripple the next, merely because of improper safety precautions. Many accidents can be prevented on the job, in the home, on the highways, in the schools, and at vacation spots.

Highway accidents rank among the ten leading causes of death in the United States. The number of serious injuries is even greater. Many people are left permanently crippled in one way or the other. The car manufacturers build many safety features into the cars, such as seat belts, which are not used by many drivers. The costs of automobile accidents in terms of dollars, injuries, and deaths are shocking. Even more disturbing is the fact that most of it is needless.

CAUSES OF ACCIDENTS

There are two basic causes behind automobile accidents–mechanical failure and human failure. The automobile may have mechanical failures, such as bad brakes, improper lighting, or steering problems. Mechanical things, such as traffic lights can fail, but the most common cause of traffic accidents is human failure.

Human failure results from many different causes. The physical condition of the driver may be the reason. The emotional attitudes of the driver can have a large effect on his driving. Bad health or being emotionally upset can cause a driver to do things and take chances normally not considered. Nearly 90 percent of all traffic accidents are caused by improper driving. If everyone would practice sensible driving, accidents would be decreased in number.

Driving an automobile is a serious responsibility. The modern automobile is a high-powered mass of steel with great destructive power. It must be handled with knowledge, skill, and respect. Let us examine some of the factors which affect driving.

Condition of the Driver

Fatigue is a common cause of traffic accidents. When one is tired, reaction time is much slower than normal. It becomes difficult to think clearly in an emergency situation When a driver is extremely tired or unable to function properly, it is wise to let someone else do the driving. Worry also has a bad effect on a person's ability to drive Thinking about problems instead of keeping one's mind on driving is often the case. Driving on turnpikes or freeways can make a person drowsy. There are no sharp turns or side roads to worry about, therefore the driver tends to become too relaxed. Almost 40 percent of the fatal accidents on turnpikes are due to the driver's loss of alertness, or to actually falling asleep at the wheel. The sensible driver is aware of these hazards and will pull off the road when fatigue sets in.

There are also physical defects which can cause a person to have an accident. Anyone suffering from diseases of the nervous system or heart should discuss the hazards of driving as it pertains to a health problem, with a doctor. When a person has a defect in vision or hearing, it must be corrected. This is why drivers license examinations in many states require tests.

Alcohol is a major cause of traffic accidents. At least 50 percent of all accidents are caused by drivers who have been drinking. The sensible driver will not drive a car at all after taking more than one drink. Some authorities believe that when drinking has been moderate, driving is safe if one hour has elapsed for each drink which was drunk. Passengers also have a responsibility not to ride with a driver who has been drinking.

It has also been found that driving patterns may be affected by emotional problems. Certain types of persons cause more than their share of accidents. It is thought that these persons find some sort of satisfaction out of speeding and reckless driving

Condition of the Car

Every automobile should be checked at regular intervals to make sure that it is safe to drive. Lights, including headlights, rear lights, and stop lights, and brakes are often found to be in need of repair. Defective brakes and lights account for many of the accidents.

Other items, such as tires, exhaust systems, steering mechanisms, windshield wipers, cooling systems, and mirrors need to be checked regularly to ensure proper operation. Many states have a requirement for annual inspection of all cars

Seat belts can save your life. Some 5,000 highway deaths could be prevented each year if seat belts were used by drivers and passengers The sensible driver uses the seat belts and requires all passengers to do so A common mistake is using seat belts only on longer trips The danger is just as great and perhaps greater, on short drives Most accidents occur within 25 miles of the driver's home.

Proper Driving Instruction

Everyone who learns to drive should learn the proper way from the beginning. Many high schools have driving courses, in which a student learns from a qualified professional instructor. The cars are usually equipped with dual controls

for added safety. Insurance companies recognize the advantage of such instruction by providing lower premiums for those drivers who have had driving courses. The sensible driver attempts to take advantage of the instruction available, including refresher courses or courses on defensive driving.

Speeding and Other Hazards

The number one direct cause of serious traffic accidents is driving too fast for road and traffic conditions. Driving too fast is not always a matter of exceeding the legal speed limit. Road and traffic conditions can make a 20 miles per hour speed hazardous, even though the posted speed limit is 55 miles per hour. Almost half the accidents occuring in cities, including those caused by driving too fast, involve speeds of 30 miles per hours or less.

Speeding occurs for different reasons. Some drivers get a thrill out of fast driving. Others are impatient or need to make up for lost time. The sensible driver maintains safe speeds. Speeding, racing, dragging, and other forms of hazardous driving account for a very large percentage of accidents among teenage drivers.

Driving to the left of the center line is the second most common cause of accidents. This may happen when passing or when the driver is not paying attention. The drinking driver is often at fault here.

Third place in causing accidents is following too closely, or tailgating. Other dangerous practices include failure to yield right-of-way, failure to stop at signals, failure to signal turns and stops, and disobeying traffic laws and signs. A good driver is aware of all these hazards and conforms to the rules established for driving safety.

The path to highway safety can be summarized by the three "E"s of safe driving. These are Education, Engineering, and Enforcement. Education is the best route to accident prevention. An educated driver has developed the necessary skills and mental attitude to safely handle the automobile. Engineering provides us with roadways which are designed for safe driving. Control signs, speed limits, and parking restrictions reduce accidents in heavy traffic areas. Enforcement, the third E, is concerned with seeing that the laws are obeyed. A traffic ticket may prevent a reckless driver from self-danger and from endangering other drivers. It is a small price to pay.

Stopping Distances

Stopping distances are important to road safety. Stopping distance is the distance the car travels from the reaction time of the driver to a complete stop of the car. Driver reaction is around 3/4 second, under average conditions. This is the time it takes for the driver to recognize the need to stop and depress the brake pedal. The braking distance is the additional distance required for the car to stop after the brake is applied. The braking distance increases with poor road and weather conditions, drowsiness or inattention of the driver, or the use of alcohol. Stopping distance can be approximated in the following way Divide your speed by ten, and multiply this number by the speed. The answer is the stopping distance in feet. For example, 30 miles per hour times 3 gives a 90 ft. stopping distance; 40 miles per hour times 4 gives 160 ft. The distance travelled by the car during the reaction time must be added to these distances. The sensible driver always allows a safe stopping distance between cars and constantly looks ahead.

"Take time to be safe" and "Slow down to live" are sayings which, if abided by, will prevent many traffic accidents and save lives.

DRUG ABUSE

WHAT IS DRUG ABUSE?

The word drug refers to any active substance used in the treatment of illness, or for recreation or pleasure. This would include aspirin, penicillin, antihistamine, antiacids, and other commonly used medication. It also includes the drugs which affect the mind, such as marijuana, LSD, cocaine, amphetamines, and heroin. To complete the list, alcohol and tobacco are also classified as drugs. Medicinal drugs are a necessary part of our society. They cure the ill

and relieve pain for those afflicted with certain diseases or disorders. Without the proper use of drugs, there would be much more pain, suffering, and death in the world today.

The improper use of drugs implies that the drug is taken for unnecessary reasons. An unnecessary reason is usually related to attempts to influence the mind and body in an unnatural way. The person who misuses drugs is trying to alter emotions and senses to escape from the reality of life. The term "drug abuse" refers to the use of a drug or drugs to the extent that the individual's health is endangered or the social adjustment is impaired. Why does anyone use drugs to the point that health is destroyed or adjustment to the world around oneself is destroyed? Let us look at this for a moment.

Generally, those who misuse or who abuse drugs fall into three categories. These are:

Situation user–those persons who misuse drugs in a particular situation and at certain times. Someone who wants to sleep but cannot, truck drivers who want to remain alert, students wanting to score high on a test, are examples of situation users.

Spree users–those people who want to have some "fun" by experiencing the mind-altering effects of drugs such as LSD or marijuana, or the excitement produced by cocaine. Normally the "high" is desired for an extended time such as a night or a weekend.

Hard-core users–the real victims of drug abuse. They have become dependent on the use of drugs. Their whole life involves the drug experience to the point where family, friends, and other aspects of a normal life are no longer important.

It is true that many people who are situation or spree users may suffer no long-term effects, but some of them will eventually end up as hard core users. These are the real unfortunates. But there are other reasons for avoiding the situation or spree misuse of drugs. Let us look at some of these.

1. Drug misuse or abuse is not wise from the medical point of view. It can be dangerous to your health. Overdoses of some drugs can kill you. Death or serious illness from overdoses many times involve people who are not hard-core users, but those who are experimenting with various drugs. The hard-core user has less resistance to sickness and disease than the normal, healthy person. If you are "mainlining"–using needles to inject drugs into your body–there are serious problems which can arise from unsterile conditions.

2. Drug abuse can ruin your appearance. It has been shown that long term use of drugs will change the way you look. The hard core user will usually neglect personal hygiene, and actual physical break-down will occur.

3. Drug abuse will cost you money. The continued use of drugs is an expensive habit. Cigarette smokers can easily spend over a dollar a day on their habit. Heroin users may spend $20 to $80 or more a day in keeping their habit supplied. In many cases, crime becomes the only way to get this kind of money.

4. Drug abuse can endanger your safety. Those who use drugs are more likely to have accidents than those who do not. While under the influence of drugs, there is little concern for personal safety or that of others. Drugs can also make you think that you can do things beyond your physical ability, which helps to cause accidents.

5. Drug abuse can lead to dependency. The continuous use of drugs can lead to physical or psychological need for the drug. This means that you must have the drug at all times–7 days a week, 52 weeks a year, with no time off for holidays. Food, sleep, and shelter become secondary to getting the next "fix". When you try to stop using drugs, on which you have become dependent, you are subject to "withdrawal" symptoms. These can be very painful and almost impossible to endure.

6. Drug abuse is illegal. It is against the law in every state and every country and can carry heavy penalties. The spree or situation user is breaking the law just the same as the hard-core user when he uses or experiments with a drug. Sometimes arrest can be only an inconvenience to the hard-core user, but it can spell disaster for the experimenter. It causes embarrassment, interruption of education, and family problems. And, a police record can mean that certain

career fields are closed or restricted. In short, a drug arrest for even a first offense can have lasting influence on your life.

7. Drug abuse is antisocial. Many people experiment with drugs as an entry to certain kinds of social life. It represents something different from the "straight" world. Instead of a friendly, exciting world and new friends, the user may find contacts are limited to other users, pushers, and dealers. The world can be a wonderful place, full of opportunity for the young person. The use of drugs can keep a person from meeting and enjoying other people.

8. Drug abuse is illogical. Drug abuse appeals to the emotions, not to the mind. It is not a need, it is a personal choice which the user makes. The body must learn to tolerate the misuse of drugs. The first-time user may become nauseated or sick, because drugs are foreign to the human body. To become a user of most drugs requires a firm decision to overcome the physical and mental problems which accompany the use of drugs.

9. Drug abuse can mean long-term suffering for the user and his family. When drug abuse leads to legal problems, health problems, or family problems, the effects are long-term. A criminal record or a broken family is a long lasting thing. Some of the long term health effects of drug abuse are not even known. They may be much worse than people think today. Are things ever so bad that a few hours of escape are worth the chance of a lifetime of suffering?

10. Drug supplies are not dependable There are no laws to protect the drug user against a bad or contaminated supply. Illegal sources are always suspect. The user may not know from one time to the next how good the supply is, not realizing what is being received.

These are the reasons for avoiding even the situation or spree use of drugs. But yet many young people today do experiment with drugs. What are some of their reasons? Let us see.

"I just wanted to get away from this lousy world."
"For kicks, what else?"
"I wanted to expand my mind."
"My friends are doing it."
"I was just curious."
"I just wanted to relax."
"I wanted to feel good."
"Because my parents told me not to."

Do these reasons make sense to you? They are excuses for experimenting with drugs, not reasons. The person who experiments with drugs is trying to change but is doing so in a very dangerous way. The experimenter can easily lose control, and drugs will become the only means of meeting the problems of life.

DEPENDENCY AND ADDICTION

Every drug which is abused has its own particular effect upon the user. Dependency and addiction refer to the need which the drug produces in the user for further drug use. In the past, very little was known about this effect, but today considerable research is being conducted to answer some of these questions. We need to consider some definitions.

Addiction is a state of periodic or chronic intoxication produced by the repeated use of a drug. Its characteristics are

1 An overpowering desire or need to continue taking the drug and to obtain it by any means.
2. A tendency to increase the dose
3. A psychological and physical dependence on the effects of the drug
4 An effect which is bad for the individual and for society.

Drug Dependence is a state arising from a repeated use of a drug on a periodic or continuous basis. Its characteristics will vary with the drug involved. This is made clear by stating the particular type of drug dependence in each case—for example, drug dependence of the morphine type, of the cocaine type, of the barbiturate type, etc.

Habituation is a condition resulting from the repeated use of a drug which includes the following characteristics.

1. A desire (not overpowering) to continue taking the drug for the sense of improved well-being that it produces.

2. Little or no tendency to increase the dose.
3. Some degree of psychological dependence, but no physical dependence.
4. A bad effect, if any, on the individual but not on society as a whole.

Physical Dependence is adaptation of the body to the presence of a drug. The body develops a continuing need for the drug. Once such dependence has been established, the body reacts in a certain way if the drug is suddenly withdrawn. The nature and severity of the withdrawal symptoms depend upon the drug and the daily dosage level obtained.

Psychological Dependence is an attachment to drug use which arises from a drug's ability to satisfy some emotional or personality need of an individual. This attachment does not require a physical dependence. A person may be psychologically dependent on substances other than drugs.

Tolerance is the tendency for a user to keep increasing the dosage to maintain the same effect. Tolerance develops with the barbiturates, amphetamines, and opiates.

Just what do we mean by the term "hooked"? In the worst case, it applies to physical addiction, which almost always leads to dismal results But one can become dependent in one of the various ways defined above to such drugs as alcohol, tobacco, or even the caffeine in coffee The point is that there are several different ways in which a person can become dependent upon the use of drugs Some have severe implications, while others are less severe. All are important because they encourage the continued use of the drug

TYPES OF DRUGS

Drugs may be divided into five categories. These are

Stimulant
Depressant
Hallucinogen
Delirant
Narcotic

A stimulant is a drug which speeds up the action of the central nervous system. Stimulants induce a temporary sense of well-being and self-confidence. They combat fatigue, curb the appetite, and reduce depression. Generally, stimulants include:

Cocaine	(Coke)
Amphetamine	(Bennies)
Dextroamphetamine	(Dexies)
Methamphetamine	(Speed)

The stimulants as a group are known as "uppers". Amphetamines work by acting like the natural hormones produced by your body. They stimulate certain areas of the nervous system which control blood pressure, heart rate, and breathing. All of these reactions increase when the drug is taken. They can keep the body in a state of stimulation for long periods of time. These drugs create a dependence, and tolerances of intake increase rapidly. This requires higher and higher doses to obtain the original effect. Use of the drug can produce psychological dependence in a few weeks. When coming down from a "high", the user suffers extreme depression, and suicide during such periods has occurred. Cocaine has become common on the drug scene in the United States in recent years. The body does not develop a tolerance to cocaine, but dependency does develop. Overdoses are not rare and cause death in many cases. Long term use of cocaine results in both mental and physical breakdown of the user.

A depressant is a drug which relaxes the central nervous system. They make up the group called "downers". Generally, depressants include

Alcohol	Barbiturates
Tobacco	Opiates

Barbiturates are phenobarbital, pentobarbital, secobarbital, and amobarbital. They go by such names as downers, barbs, red devils, yellow-jackets, phennies, goof balls, blue heaven, candies. Opiates are the opium derivatives of heroin, morphine, and codeine. Such names as stuff, junk, horse, morph, smack and others are applies to this group. The opiates have great medicinal value as pain relievers, and this could

be why they are attractive to abusers. They are physically addictive, which means that the body develops a need for the drug. The danger lies in the tolerance developed, which makes the user require repeated and larger doses. Since opiate use is usually by injection, a great danger from contaminated injections or overdoses exists. In New York City alone, 1000 deaths a year occur from these causes.

A hallucinogen is a drug which produces a distortion of how the user sees reality. They can cause wild dreams and weird visions, and can produce extreme and dangerous behavior by the user. Hallucinogens include:

Marijuana	Peyote
LSD	Psilocybin
Mescaline	DMT
STP	

The long term effects of most of the drugs are relatively unknown. With the exception of mescaline and peyote, they are relatively new, and data on such effects are not available. While psychological dependency can result from use of these drugs, physical addiction does not.

A deliriant is one of a large group of substances which cause mental confusion when inhaled. They include such things as

Aerosol products	Paint thinner
Airplane glue	Gasoline
Lighter fluid	Cleaning fluid

Inhalation, or "sniffing" can cause nausea, dizziness, shakiness, and muscle spasm. The effect is a "high" dreamlike state, sleepiness, disorientation, and stupor. This type of drug is extremely dangerous, especially to the experimenter. Fatal accidents have repeatedly occurred.

The term narcotic refers to opium and to pain relieving drugs made from opium. These drugs are depressants, but are included in a separate category because they cause physical addiction. Cocaine, even though it is a stimulant, is included in the narcotic category for law enforcement purposes. This group includes

Opium	Percodan
Heroin	Demerol
Morphine	Cough syrups
Codeine	Cocaine

Once "hooked" or addicted to a narcotic drug, obtaining a contained supply becomes the main goal in an addict's life. Concentration on getting money for drugs often prevents the addict from continuing an education or a job. Health is often bad. There may be sickness one day because of withdrawal effects and sickness the next day because of an overdose. The life span may be shortened by 15 to 20 years. Frequently there is trouble with the family and often with the law. The addict lives to support addiction.

THE HISTORY OF DRUG USE

Drugs that affect human behavior have been known all through recorded history. Even people of the stone age may have used some of the common drugs of today. Primitive tribes used these drugs in religious rites or to prepare warriors for battle. Marijuana was known to the Chinese as far back as 2700 B.C. It was used to ease the symptoms of various disorders. From earliest days, medicinal use of drugs had importance as it does today.

Medically, the most important of these drugs is opium It was known to the Egyptians as early as 1500 B.C. It has been an important sleep-inducing and pain-relieving drug for several thousand years, as it is today By the beginning of the Christian era, it was used to relieve the symptoms of cough and diarrhea, as well as to reduce pain and induce sleep In Europe, opium was used to treat hysteria, thus becoming one of the first medicines for use in treatment of a mental disorder.

Since earliest times, non-medicinal use of opium has been prevalent. It has the power to relieve anxiety, gloom, and despair. It provides escape from boredom and loneliness. It permits a person to escape from reality, giving relief from circumstances which produce despair. In such use, a drug is termed a "drug of indulgence".

By the 18th century, opium was used by doctors in the American colonies. It was used as a pain-reliever for such diseases as cancer, gallstones, and dysentery. It was also used for

relief of simple diarrhea, vomiting, spasms, toothache, and pains of childbirth. Many of these uses are continued today. Despite its widespread medicinal use, the possible addictive effects of opium were not understood. The dangers were increased in the 1800's by the discovery of two opium derivatives, morphine and codeine. Morphine is about ten times as potent as opium, and for this reason it became popular among opium users. One extremely unfortunate result of this situation was that patients who were treated with opium or its derivatives for logical medicinal purposes became addicted to the drug. Long after the original injury or disease was cured, the patient was left with a deadly habit.

One of the big factors in the growth of narcotic abuse was the invention of the hyperdermic needle. It was invented in 1843, and brought to this country in 1856. It was used to give morphine during the Civil War. Many soldiers on both sides came back from the war addicted to the drug. By 1880, the use of the needle by addicts was widespread.

After the Civil War, opium use took several forms. Laudanum was a mixture of one grain of opium to 25 drops of alcohol. Paregoric was one grain of opium to 480 drops of alchol. Dovers powder was opium mixed with milk sugar Pulverized opium was also used in suppository form. All of these had legitimate medicinal uses, but they were also widely used by addicts. Opium was also smoked, which was a practice introduced by Chinese immigrants.

Because it was an effective medicine, opium and its derivatives were available in almost any drug store. There were no controls on its use. Many people became addicted by using the drug at first for medicinal purposes. Then, in 1898, a new form of the drug was discovered. This was heroin. It again was first used for medicinal purposes. In fact, it was used as a treatment for morphine addiction, just as morphine had first been used to treat the opium habit. Heroin proved to be more addictive. At last, medical authorities became convinced of the dangers of drug addiction.

At the same time, public attitude towards addicts was changing. At first, people felt sorry for them. The drug was blamed, not the addicts themselves. Around 1900, doctors began to realize the destructive nature of the drug, especially in the form of heroin. It was determined that the problem was very large. Many people had become addicted. The public saw addiction as an illness or vice, but in either case it became apparent that some controls were needed. An association between addiction and crime began to develop.

In 1909, the United States government passed laws against importing opium and its derivatives except for medicinal use. By 1912, the cities and states had laws requiring prescriptions for purchase of the drug. In spite of this, purchases without prescriptions could still be made. This was because the laws were not really enforced. Finally, in 1914, Congress passed the Harrison Act. This act put force into the narcotics laws. It required registration of all persons dealing with narcotic drugs. The act made it federal law that only doctors could dispense narcotics, and that prescriptions were required for purchase.

Court decisions affecting the enforcement of the Harrison Act made it illegal for a doctor to prescribe drugs to maintain a habit. He could only prescribe smaller and smaller doses in order to break the drug habit. Soon, attempts were made to operate clinics for addicts, but these failed because of public pressure.

Now the addicts were cut off from all legal sources of drugs. The underworld market began to grow Prices on black-market narcotics increased, and addicts were forced into criminal activities to support their habit. Illegal drug traffic grew enormously, as did the drug-related crime rate. It became necessary to control the addicts, as well as the pushers. This lead to the opening of the treatment facilities at Fort Worth, Texas, and Lexington, Kentucky, in 1929. This together with a tough crack-down on traffic activities, reduced the number of addicts to 60,000 by the beginning of World War II.

During the war, people did not think much about the narcotics problem After the war, it became apparent that younger people were becoming involved with narcotics. Stiffer laws were passed, and penalties were increased. The problem has grown almost steadily until today, in spite of efforts by law enforcement and public welfare officials.

HOW ILLEGAL DRUGS ARE OBTAINED

In spite of strict laws governing narcotics and other dangerous drugs such as amphetamines, barbiturates, and tranquilizers, drugs capable of serious abuse do slip into the illegal drug market. They do so in one of several ways:

Illicit operations—this refers to the actual manufacture of the drug by criminals. Such operations usually result in inferior products, some of which may be dangerously contaminated. A second kind of illicit operation is the use of a "front organization". This is a phony company set up to buy drugs from the legitimate manufacturers.

Smuggling—this refers to the illicit importation of drugs or other prohibited substances. This is usually done by ship or aircraft, which bring the drugs into the United States from foreign countries. Heroin, for example, is completely outlawed in the United States and most other countries. It can only be brought into the country by smuggling. Most of the marijuana and cocaine seen in the United States is also smuggled in. Most smuggling operations are run by organized crime syndicates.

Bulk Peddlers—these are the supply points for the pushers. They buy from illicit manufacturers, smugglers, or other large scale sources and distribute to the various forms of pushers

Obtaining legal products by fraud—this refers to the obtaining of drugs from a doctor or drug store by forging or altering a prescription. Some addicts are very good at this. Some even know enough about medicine to trick a doctor into writing a prescription for drugs They do this by pretending to have certain diseases which require treatment by the drug.

Illegal sales by druggists and doctors—Even though most druggists and doctors are honest, respectable people, there are a small number who use their position to make money by selling drugs. They can do this because the public has placed its trust in these people, and they abuse it.

There are other minor sources, such as theft, but the ones mentioned above make up the major sources of illicit drugs in the United States.

PENALTIES FOR ILLICIT DRUG TRAFFIC

Drug laws and the penalties arising from them vary from state to state. The federal law relating to drug abuse is the Comprehensive Drug Abuse Prevention and Control Act of 1970. It provides for rehabilitation, control and enforcement, control of import and export, and reports from advisory councils regarding drug abuse. The law covers all drugs, from heroin to tranquilizers. The criminal penalties provided by this act vary according to the substance involved. Manufacture or distribution of illicit drugs is punishable by up to 15 years in prison, depending upon the kind of drug The selling of marijuana carries a one-year sentence. If a person is involved with five or more other persons in the illicit drug traffic, the mandatory sentence is not less than ten years and up to life imprisonment. So, the federal law is fairly tough on those who traffic in illicit drugs

TREATMENT FOR DRUG ADDICTION

In past years, drug addicts were almost always beyond help. This was especially so for those using drugs for which a tolerance develops. Not long ago, treatment consisted of "detoxification", a fancy word for drug withdrawal. This was extremely painful and seldom provided a lasting cure Today, controlled detoxification is used, whereby the withdrawal is at a slow pace This is done under strict medical supervision. It is accompanied by other treatment designed to help the addict through the withdrawal. This is a complex procedure, and there are not a sufficient number of clinics available to provide it. But there is a

concentrated effort to provide more facilities for this purpose.

Often you may hear reference to the "British System" for treating addiction. In England, drug addiction is considered to be a disease, not a crime. Doctors there may prescribe narcotics for addicts in amounts required to maintain the habit. This is not done until every effort has been made to cure the addict. Abuse of the system has resulted in a large-scale black market for narcotics in England, and authorities are considering modification of the laws.

There is currently a large amount of money being spent on research into means of combating drug addiction. New methods of treatment and rehabilitation have been placed into operation on a test bases. Most of these programs are still considered experimental.

SOME THOUGHTS FOR YOU

Now that you have studied drug abuse and its history, the various kinds of drugs, and the destructive effects of these drugs, you probably have some ideas of your own about the subject. Let us look at some typical thoughts. It is often said that older persons who warn against drugs are hypocrites who use alcohol, tobacco, and tranquilizers. Well, they probably find it hard to give up their "crutches". They probably wish they had never started Why not be smarter than they were?

It is often said that marijuana is no worse than alcohol. But alcohol is the nation's number one drug problem. Why develop a new problem that is no worse than the worst. It is often said that hallucinogens such as marijuana, LSD, Mescaline, STP, Peyote, and others expand the mind. Actually they produce illusions and distortions, and cause the senses to react strangely Why not change reality rather than distort your sense of reality? Work constructively for a better world.

It is often said that stimulants such as amphetamines, cocaine, or speed increase the user's mental abilities. Actually, they draw on the body's reserve energy. Repeated use will exhaust the mind and body. Why not find your limits by natural means?

It is often said that depressants such as barbituates, opiates, and alcohol slow the world down and make problems smaller. Actually, they slow you down, not the world. They dull your capacities and make you less effective. Why fool yourself into thinking that not caring solves problems?

It is often said that trying just once never harmed anyone. But the law makes no exception for the first time. Most hopeless addicts started by trying "just once". Why think that you will be lucky and not get hooked?

Think about these. Have you heard them from your friends? Have you thought of them yourself?

ALCOHOL ABUSE

ALCOHOL AS A DRUG

Alcohol is classified as a depressant. It is in all respects a drug, and alcohol abuse happens to be the number one drug problem in the United States today. Yet, most people do not think of alcohol as a drug. This is probably because of its widespread use in our society, and the fact that alcoholic beverages have been around almost as long as man himself It has traditionally been used with meals, social gatherings, in religious ceremonies, and on joyous occasions. Like any other drug, alcohol has its proper uses, but it also has great potential for abuse.

ALCOHOL AS A SUBSTANCE

Alcohol is a natural substance which is formed by the interaction of sugar and yeast. Ethyl alcohol is the form which is often consumed by human beings in beer, wine, and hard liquor. Medically, it is a depressant drug which slows the activity of the brain. When consumed in excess, it can cause severe physical

and emotional damage to drinkers, as well as to those around them.

Alcohol is absorbed directly into the stomach lining. It does not have to be digested to be absorbed, therefore it takes effect very rapidly. Once alcohol enters the blood stream, its effects continue until it is completely used up by the body. How long the effects remain depends upon the body size of the individual. Roughly speaking, the average 150-pound person requires about 1 to 1 1/2 hours to absorb and discard one drink (or one beer, or 5 ounces of regular wine). This means that if a person consumes 10 drinks, it will take about 10-15 hours to "sober up".

A person becomes intoxicated or "drunk" when the alcoholic content in the blood stream becomes high enough to noticeably effect brain activity. Intoxication proceeds through several stages. The first stage is a "happy" relaxed state in which the person is usually talkative and sociable. Some loss of judgment and efficiency is experienced in this stage. Later, the individual may become excited and experience impaired ability to think and control his actions. As alcoholic consumption continues, the individual becomes confused and moody. Finally, the person may go into a stupor or coma and may even die as a result of respiratory paralysis if enough alcohol has been taken at one time.

ALCOHOLISM

Alcoholism is a term used to describe the condition of a person who has become dependent upon alcohol. A person who is an alcoholic uses alcohol to ease a personal problem or problems. Such an individual has lost control of his or her drinking to such an extent that drinking becomes an end in itself and dominates all other aspects of the person's life. Alcoholism is a disease which progresses through stages. Early signs may be an increase in alcohol consumption to relieve tension or escape problems. The individual may begin to require more alcohol for the same effect and have trouble stopping once started. Later signs of alcoholism may include drinking alone and during the early part of the day. The individual may develop guilt feelings about drinking and may try to conceal it. Finally, the alcoholic reaches a stage where drinking becomes the primary goal in life. Suffering from poor health in one form or another, shortening his or her life from 10 to 20 years and the loss of family and job may be the result. Another good indication of alcoholism occurs when personal problems come about as a result of alcohol. Such problems may range from simply missing work (or being late) because of a hangover, to manslaughter as a result of driving while under the influence of alcohol.

Alcohol is the most abused drug in the world today. There are an estimated 9 million chronic abusers of alcohol in the United States alone. Most of these people (95%) are educated persons who are normally responsible citizens. An important social problem of alcoholism is that alcohol consumption is often encouraged, while nondrinkers may be criticized under certain circumstances. This is sometimes a problem in the Navy Getting drunk on liberty or at "happy hour" is often considered an important aspect of fellowship. While most officers and men in the Navy handle this condition responsibly, many over-consume. While there may be no stigma attached to infrequent over-consumption of alcohol in the Navy, there are considerable penalties for those who have a "problem" with alcohol. These penalties range from a loss of personal respect to withdrawal of security clearances or discharge from the service Unfortunately, many persons in the Navy conceal alcohol problems until these problems are out of hand in order to avoid the penalties This is particularly unfortunate because the first stage in the treatment of alcoholism requires the self-admission that there is a "problem"

Many experts maintain that alcoholism can be treated but can never be "cured " It is often maintained that alcohol is both physically and psychologically addictive and that the psychological addiction is never really over Whether these theories are ever fully verified may not be as important as the realization that the first stage of treatment is complete honesty about the problem. In other words, the

over-consumption of alcohol must be admitted as a problem and faced directly by the individual. Most experts agree that the next stage of treatment is complete abstinence. The person must stop drinking entirely! The alcoholic may not be able to do these things alone. He or she may need considerable help, not only from family and friends, but also from professionals. There are many excellent organizations designed to help, one of which is Alcoholics Anonymous. These organizations are more than willing to assist, but they all require the first step. . .the honest admission of the problem by the abuser.

PART E

NAVIGATION

Ever since people began to move from place to place in the world, a method of navigation was important. When a person put to sea, navigation was the only way he or she could be assured of returning to port.

In this part, you will study navigation in many ways. You will learn about the maps and charts used by navigators and all of the information that can be found on maps. You will also study some of the devices and instruments used in navigation. You will learn about the compass, the sextant, the pelorus, the fathometer, and many others.

Because the measurement and accurate calculation of time is so important to navigation, special attention will be given to time and time pieces. You will also take a very close look at compasses and some of their problems.

The information on this part will be found within this text.

INTRODUCTION TO NAVIGATION

NAVIGATION DEFINED

Navigation is simply the art and science that enables the mariner (or aviator) to (1) determine the ship's position, and (2) guide her safely from one point to another. You already have a good idea of how a ship's compass is used in guiding her from one point to another, but how does her navigator figure out where he or she is in the first place?

The only way to locate any object is to describe its position with relation to some other object(s) whose location is already known. If you doubt this, try and dream up another way to locate something. Try to tell yourself where your hat is, right now, without bringing some other object into the picture Either your hat is on your head, in your locker, or in, on, or near some other object you can locate If it is not then you do not know where it is

We have four ways of determining position in navigation Each one locates a ships position with relation to some locality, or object(s) whose location is already known. These four methods of finding position are

1. Piloting, in which position is determined by means of bearings on or distances from visible objects on the earth's surface, and by soundings.
2. Dead reckoning, in which position is obtained through the direction and distance a ship has traveled from a known point of departure
3. Celestial navigation, in which position is found by locating a ship with relation to the celestial bodies
4. Electronic navigation, in which position is determined much as it is in piloting, except bearings and/or distances are obtained by electronic means.

By utilizing these methods of calculating ship's position, her course can be kept on charts in the pilothouse.

TERRESTRIAL SPHERE

Let us say you are looking at a white cue ball with an absolutely blank surface. Take a pencil and make a mark on it. Now, how would you tell anybody where on the cue ball the mark is located? The answer is You could not There are not points or objects on the cue ball with reference to which you can locate the mark

The earth is a sphere, just as this cue ball is. It is called the terrestrial sphere Although it is a little flattened instead of being perfectly spherical, this fact is omitted here for simplicity. Reference points for location of objects on the earth have been established by general agreement among maritime nations These are the north and south poles, located at the ends of the axis on which the earth rotates. The imaginary lines running through the poles and around the earth are called meridians. They divide the earth into sections, the way an orange is divided into segments.

Now, suppose you start at the north pole and travel along a meridian exactly half way to the south pole You will then be on the equator, an imaginary line running clear around the earth,

which bisects every meridian and divides the earth in half. The half the north pole is on is called the northern hemisphere; the other half, the southern hemisphere.

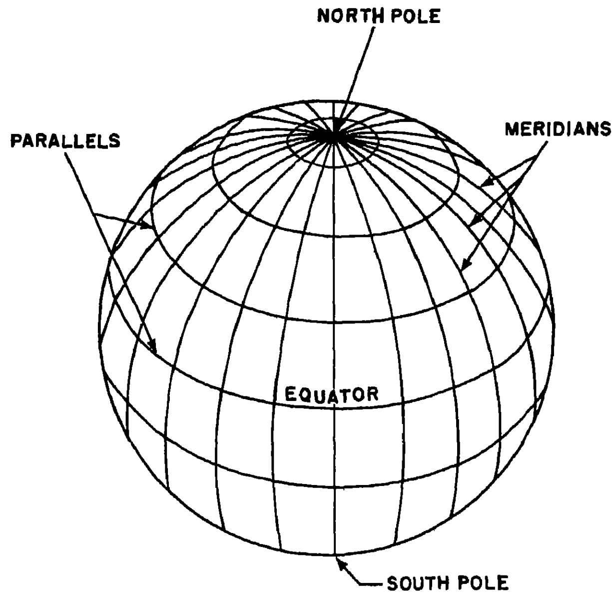
CIRCULAR MEASUREMENT

Before going any further, you will have to know something about how distances are measured along the circumference of a circle. Measurement along a meridian is expressed in terms of degrees of arc. These degrees of arc may be transformed into linear measurements in nautical miles (described later). The best example of circular measurement in degrees of arc is the compass card. Whatever the size of the card, its circumference always contains 360°. Each degree contains 60 minutes ('); each minute, in turn, contains 60 seconds (") The nautical mile equals 6076.11549 feet or exactly 1852 meters. The nautical mile is about one-seventh again as long as the statute mile.

MERIDIANS AND PARALLELS

So far, we have a series of meridians running through the poles around the earth, and a single line, called the equator, running around the earth at right angles to its axis. These reference lines can be seen in figure E-1. The equator divides each meridian and the earth itself into two exact halves.

For every degree around the earth's rim, there is a meridian, 360 of them, 60' or 3600" apart A starting point for numbering these specific meridians was required. Most of the maritime countries decided the starting point should be the meridian on which the Royal Observatory at Greenwich, England was located The Greenwich meridian is therefore number 0. Meridians run from east and west to the 180th, on the opposite side of the earth from Greenwich. The complete circle formed by the 0 and 180th meridians divides the earth into two exact halves. One of these is the eastern and the other the western hemisphere. Every meridian runs true north and south.



65.116(69)
Figure E-1.—The terrestrial sphere.

Leave the meridians, and go back to the equator. Cut a globe of the world in half, exactly along the equator. Set the northern half on the chart table, flat edge down Get your eye lined up so that the flat edge appears as a straight line, you will see the upper edge in the shape of a semicircle, containing 180° of arc, 90° from equator to pole on either side

As you look at the equator, you see lines that appear to be parallel to it, one for each of the 90° of arc from the equator to the north pole. The planes forming these lines on the earth's surface are parallel to each other For this reason, they are called parallels (See fig. E-1) If you shift your eye to a point just above the pole, you can see they are actually circles, growing increasingly smaller as they get farther from the equator and nearer the poles. Remember, no matter how small a circle is, it still contains 360° The distance represented by each degree becomes less as the parallel circles get smaller.

The starting point for numbering the parallels is the equator, the 0 parallel. Parallels

are numbered from 0° to 90°N. and S. of the equator. Every parallel runs true east and west.

Do not get the idea that there are only 360 meridians and 180 parallels. There is a meridian or parallel for every one of the 21,600 minutes around the complete circle of the earth's sphere. There is one for each of the 1,296,000 seconds all the way around.

There is one for each of the 12,960,000 tenths of seconds. The parallels and meridians are imaginary. Because there is no limit on the imagination, there is no limit to the number of meridians or parallels that could be imagined on the earth. You could imagine a couple of trillion of them crowded between your two feet. However, there is a limit to the capacity of our instruments. We seldom break down measurement along a meridian or parallel to a value smaller than that of a second.

LATITUDE AND LONGITUDE

We now have a network of meridians and parallels all the way around the globe Every spot on the earth is located at a point between a meridian and a parallel cross. Every point's location is described in terms of its latitude (distance in degrees, minutes, and seconds of arc N or S of the equator, measured along the point's meridian) and longitude (distance in degrees, minutes, and seconds of arc E. or W. of 0 meridian, measured along the point's parallel). Longitude is always from 0° to 180°. Latitude is never greater than 90°. Zero latitude is the equator. If you are in latitude 90°N., you are at the north pole, and whichever way you look is south.

GREAT CIRCLE

The concept of the great circle is sometimes difficult for a beginner to grasp. It is a fundamental that must be clearly understood. A great circle is any circle whose plane passes through the center of the earth or any other sphere.

What does this statement mean, exactly? Suppose you have a perfect sphere of soft rubber through which you can pass a flat sheet of thin metal. If you shove the metal sheet through the sphere so as to cut it exactly in half, you have passed it through the center. The circumference of the flat side of each half becomes a great circle whose circumference is the same size as the circumference of the sphere itself.

If you shove the flat metal through the sphere so that it does not pass through its center, the circumference of the flat side of each part is smaller than the outside circumference of the sphere.

In both examples, the flat sheet represents the plane of the circle the sheet makes when it cuts the sphere. Now, imagine we cut the earth with a similar plane. No matter how we slice it, if the plane passes through the earth's center, the cutoff circle is a great circle. If the plane passes through, away from the center, the circle it cuts is a small circle.

The equator is a circle whose plane passes through the earth's center. The equator is a great circle. The other parallels N. and S. of the equator are all small circles. Their planes do not pass through the earth's center The equator is the only parallel that is a great circle. All meridians pass through the poles, and all their planes must therefore pass through the earth's center. Every meridian is a great circle.

A great circle does not have to be a meridian or a parallel. A great circle is any circle around the earth whose plane passes through the earth's center, no matter in what direction the plane passes.

What is the practical significance of the great circle in navigation? Just this The shortest distance between two points on the earth (or on any other sphere, for that matter) is along the great circle passing through the points.

You will understand this subject better after you study the different methods of chart projection. Right now it is necessary that you

understand the fundamental concept of the great circle.

NAUTICAL DISTANCE

The nautical mile has already been mentioned. It is approximately equal to 1′ of arc along the equator, about 1-1/7 statute or land miles. The equator is a great circle, as we have seen. Therefore, if 1′ of arc along the equator is 1 nautical mile, 1′ of arc along any great circle must also be 1 nautical mile. All great circles on the earth are the same length.

How does this relationship work out, then? It means that on any chart, the meridians may be used as a distance scale. All meridians are great circles, therefore 1′ of latitude along any meridian equals 1 nautical mile. Latitude is measured along the meridian. When it comes to parallels, 1 minute equals 1 mile only along the equator, the only parallel that is a great circle. Or, to put it another way, 1 minute of longitude equals 1 mile only along the equator.

NAUTICAL SPEED

The word knots is a seagoing speed term meaning nautical miles per hour. It is incorrect to say "knots per hour" except when referring to acceleration. In the old days, a ship gaged her speed by heaving over a flat piece of wood which offered a maximum resistance to passage through the water. There was a light "log line" attached to the chip. The line was knotted, marking suitable fractions of 1 nautical mile. A man held a reel containing the log line. The instant the log was heaved from the ship, one of the ship's hands turned over a small 2- or 3-minute sandglass. As soon as the sand in the glass ran out, the reel was stopped, and from the amount of line run out in 2 or 3 minutes, the number of knots that would have run out in 1 hour was calculated.

The chip log gave only a rough approximation of a ship's actual speed. It is entirely obsolete now, and is mentioned here only to give you the historical background of the expression "knots."

NAUTICAL DIRECTION

Nautical magnetic direction usually is measured from true north or from the observer's meridian. The meridians run true north and south, the parallels true east and west.

On the old-fashioned compass card, direction was indicated by points. There were 32 points around the card. Each point had a name: N, N by E, NNE, NE by N, NE, and so on. Each point was subdivided into quarter points. The system of naming these divisions toward or away from the points themselves was difficult to remember

Modern navigators have long since adopted the system of circular measurement (360° of arc) as a means of indicating direction. (See fig. E-2.) Only the Rules of the Road and a few diehard pilots and coastwise merchant mariners still express direction in terms of points. In the Navy, even relative bearings, formerly expressed as "4 points on the bow," "abeam," "2 points

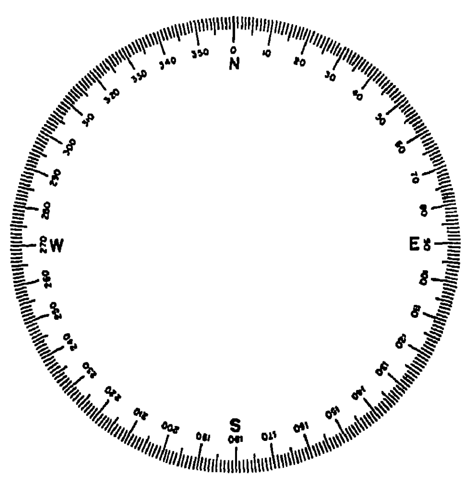


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Figure E-2.—The compass card.

abaft the beam," etc., are now given in terms of their corresponding degrees. There are 11 1/4° in each of the old style compass points.

Direction in modern navigation is always given in degrees, measured clockwise from true north, or 000°T. A course or bearing is always expressed in three figures, regardless of whether three digits are necessary. In other words, it is not 45° but 045°. It is not necessary to consider compass direction to a value smaller than the 10th of a degree. As a matter of fact, it is almost impossible to read a compass bearing or heading closer than a quarter of a degree.

BEARINGS

A true bearing is the direction of an object from the observer, measured clockwise from true north.

A compass bearing is the direction of an object as indicated by magnetic compass. It must be converted into a true bearing by applying the corrections for variation and deviation.

A relative bearing is the direction of an object from the observer, measured clockwise from the ship's head. It is indicated by the lubber's line in the binnacle, pelorus, or gyro repeater. Figure E-3 shows true and relative bearings of a lighthouse from a ship.

There will be times when you will find it necessary to convert from true to relative bearings, and vice versa. This relationship is shown in figure E-3. Note that dead ahead is 000°, dead astern is 180°, and the starboard and port midpoints are 090° and 270° respectively.

The reciprocal of any bearing is its opposite It is the point or degree on the opposite side of the compass card from the bearing. For example, the reciprocal of 180° is 000°, and vice versa. When you obtain a bearing on some object, the bearing from the object to you is the reciprocal of the bearing from you to it. To find the reciprocal of any bearing expressed in degrees, simply add 180° to the bearing If the bearing is 050°, for instance, its reciprocal is

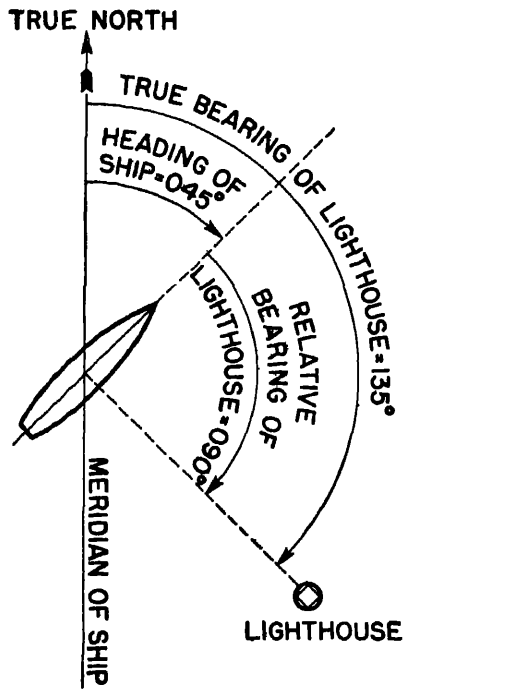

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Figure E-3.—True and relative bearings.

050° plus 180°, or 230° If your bearing is greater than 180°, subtract 180°

CHARTS AND MAPS

CHARTS

A chart is a pictorial representation of all or part of the navigable waters of the earth. You should know the methods of projection by which the curved surface of the earth's sphere is transferred to a flat plane. The best known is the Mercator system. It was devised several hundred years ago by a Flemish geographer whose real name was Gerhard Kremer. Most of the charts you will use are Mercator projections.

MERCATOR PROJECTION

If you cut a hollow rubber ball in half and try to flatten out one of the halves, you will find

you cannot do so without tearing or stretching the rubber. No section of the hemisphere will lie flat without some stretching. Projection of the curved surface of the earth onto a flat plane has the same problem. No system has been devised for a projection that preserves the true sizes of components of the original sphere. The surface of a cylinder readily opens out and lies flat without distortion, and the Mercator system of projection is based upon this phenomenon.

The discussion that follows is general. Consult Dutton's Navigation and Piloting or the American Practical Navigator, H. O. Pub. No. 9 if you desire more information.

In drawing a Mercator projection, the first detail is to project the meridians. Assume that the earth is a hollow glass ball with a powerful light shining in its center. A paper cylinder is placed around it, touching it at the equator, as shown in figure E-4. Suppose the meridians painted on the glass ball are projected onto the cylinder as vertical lines. They will be parallel to and equidistant from one another. (See fig. E-5.) The cylinder now has the meridians on its surface, and half of the Mercator projection is complete.

The next step in the projection process is to draw the parallels. Spacing of the parallels is made to agree with the expansion of the longitude scale Spacing between parallels increases as you go toward the poles, at the same ratio as the expansion of the space between meridians. The meridians and parallels are at right angles to one another. Remember, because of the sphere-cylinder relationship, the north and south poles cannot appear on the Mercator projection.

Now, unroll the cylinder and look at the projection that has been made (fig. E-6). The meridians are parallel to and equidistant from one another. The latitude lines are parallel to one another. They gradually draw apart as they become farther north and south of the equator. Above or below 80° north or south latitude, they become so far apart that Mercator projection of the polar regions is seldom used.

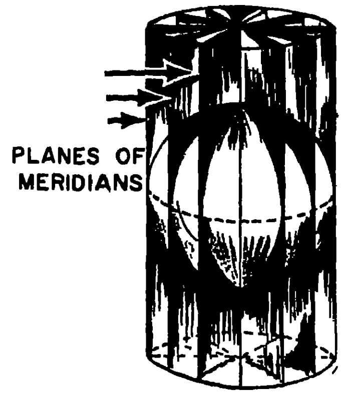

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Figure E-5.—Projection of meridians on the cylinder.

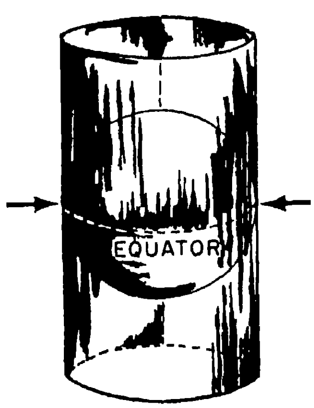

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Figure E-4.—Cylinder tangent to the earth at the equator.

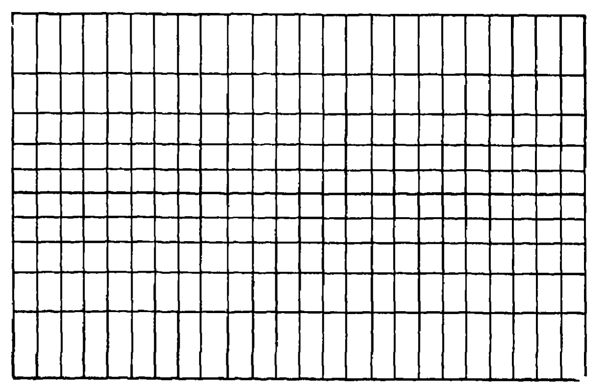

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Figure E-6.—Meridians and parallels on a Mercator projection

The space between parallels on a Mercator chart increases with latitude, but the distance represented by 1° of latitude is always the same. One minute of latitude is approximately 1 nautical mile.

On a Mercator projection 1° of latitude near one of the poles appears considerably longer than 1° of latitude near the equator. If both measurements represent the same actual distance, that distance, as shown in high latitude on a Mercator chart, may appear distorted, but actually it conforms to scale.

Figure E-7 shows the globe with actual comparative size of Greenland to the United States. But on the Mercator chart, in the background, Greenland appears to be larger than the United States. Actually the United States is a good deal larger than Greenland.

Direction on a Mercator Projection

The meridians on a Mercator chart appear as straight lines, parallel to and equidistant from one another. They represent imaginary curved lines, not parallel to one another at all, but converging on the poles.

Appearance of meridians on a Mercator projection as parallel lines is one of the most valuable features of this type of projection. It makes it possible to plot a course as a straight line (called a rhumb line). You may already know that the shortest distance between two points on a sphere lies along the great circle connecting them. Such a line crosses every meridian at a different angle. A great circle is a line of continuously changing direction. It would be generally impracticable to steer a ship along a great circle. The ship's course would have to be changed continuously to follow it.

On a Mercator projection, a straight rhumb line cuts every meridian at the same angle. In other words, it is a line of the same bearing throughout. It does not represent the shortest distance between the points it connects. This fact is not important unless very large distances are involved. That brings up the subject of great circle sailing, which is done from charts made by gnomonic projection.

GNOMONIC PROJECTION

Gnomonic projection is not especially useful to surface navigators. You simply need to know

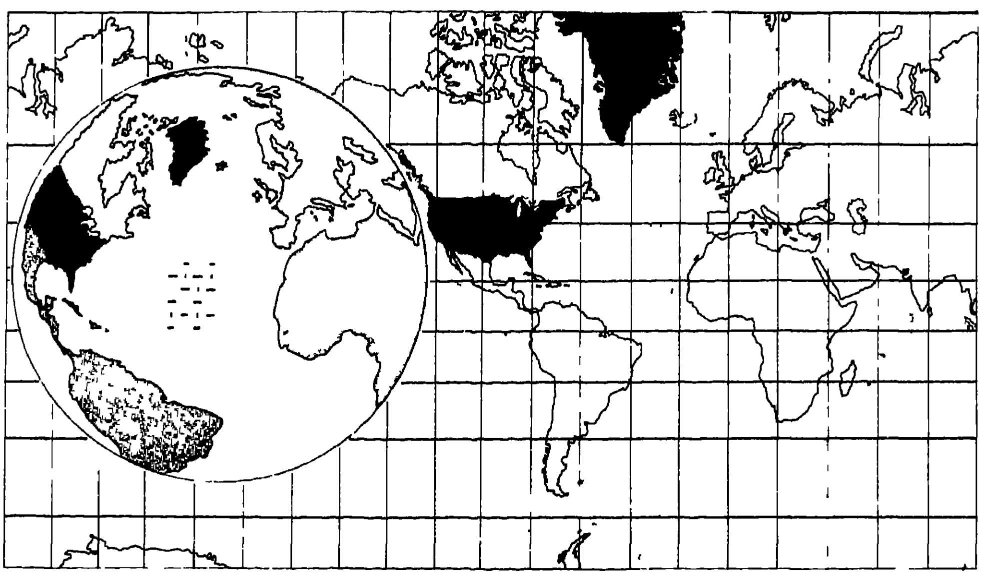

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Figure E-7.—Distortion on a Mercator chart.

that the gnomonic projection preserves the natural curvature of the meridians and parallels. You see them as though you were looking directly at a point on the surface of a globe of the earth. If the point happens to be one of the poles, then the parallels appear as a series of concentric circles. The meridians are straight lines radiating away from the pole.

Polar charts are frequently gnomonic projections. The chief advantage of the gnomonic projection is in finding the great circle track (or shortest distance) between two widely separated points. Gnomonic projections used for this purpose are called great circle charts. Gnomonic projections cannot be used directly for navigation because they do not show correct angular and spatial relationships.

GREAT CIRCLE SAILING

Suppose you are sailing from Valparaiso, Chile, to Sydney, Australia—a considerable distance. Time and expense can be saved if you sail by the shortest route. The shortest distance between any two points on the earth is along the great circle passing through the points

On a gnomonic projection, a great circle appears as a straight line (fig. E-8). Take out the great circle chart of the South Pacific, and connect Valparaiso and Sydney by a straight line. This line is the great circle track between those points You can't steer along this track because it is a line of continuously changing direction Instead, you transfer the great circle course from the small-scale great circle chart to a series of large-scale Mercator charts. Latitude and longitude of points along the great circle course are located on the Mercator charts, and are connected by a series of straight rhumb lines. The rhumb lines indicate the courses the ship actually will steer.

Great circle sailing usually is performed only over a large area. For short distances, a rhumb line and great circle course very nearly coincide. Even for long distances, the course actually steered is, in general, a composite of both tracks (fig. E-9), selected to avoid high latitudes and dangers to navigation.

SCALE OF CHARTS

The scale of a chart refers to a measurement of distance, not area. A chart covering a relatively large area is called a small-scale chart. One covering a relatively small area is called a large-scale chart. Scales may vary from 1:2,500 for plans to 1:14,000,000 for world charts. Normally, the major types of charts fall within the following scales

1. Harbor Charts—1:2,400 to 1:50,000
2. Coast and Approach Charts—1:50,000 to 1:100,000
3. Offshore Coasting Charts—1:100,000 to 1:600,000
4. Ocean Sailing Charts—1:600,000 or smaller

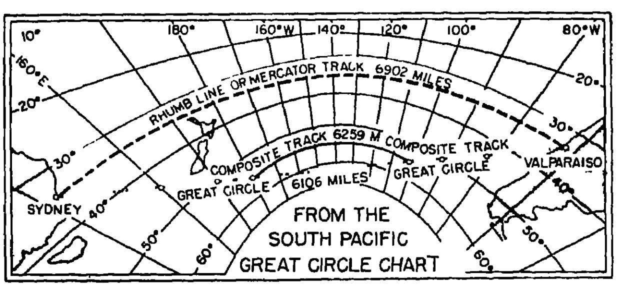

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Figure E-8.—Rhumb line and great circle course on a great circle chart.

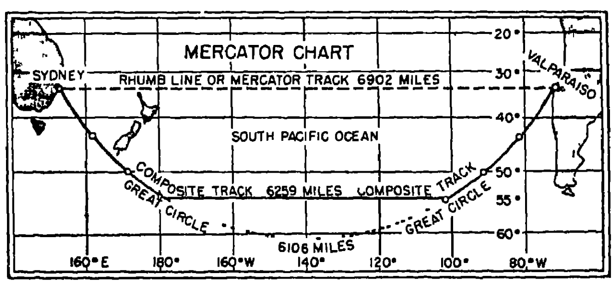

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Figure E-9.—Rhumb line and great circle course on a Mercator chart.

The size of the area shown on a chart varies extensively, according to the scale of the chart. (See fig. E-10.) The larger the scale, the smaller the area shown. Large-scale charts show areas in greater detail. Many features that appear on a large-scale chart do not show up at all on a small-scale chart of the same area.

The scale to which a chart is drawn is shown under its title in one of three ways: 1 to 5,000, 1:5,000 or 1/5,000. These figures mean that an actual feature is 5,000 times as large as it is shown on the chart. Expressed another way, an inch, foot, yard, or the like, on the chart means 5,000 identical units on the earth's surface. The larger the figure indicating the proportion of the scale, the smaller the scale of the chart. A chart with a scale of 1:5,000 is on a much larger scale than one whose scale is 1:4,500,000. Another way of expressing scale, called the numerical scale, is in inches to the nautical mile.

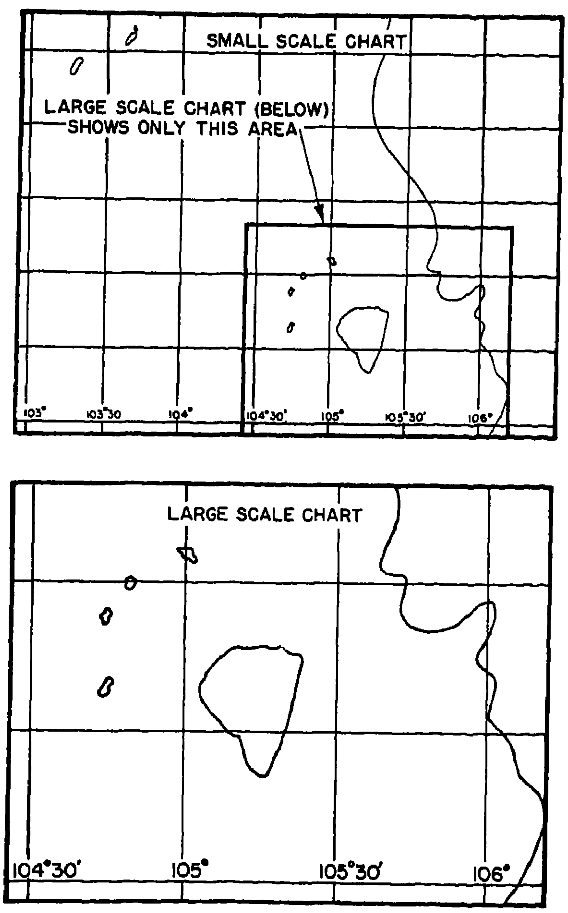

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Figure E-10.—Small-scale and large-scale charts.

You must exercise greater caution when working with small-scale charts than with large scale charts. A small error on a large-scale chart could amount to a large error on a chart depicting a much more extensive area. When navigating the approaches to land, only charts of the largest scale are used.

TYPES OF CHARTS

Charts used in the Navy may be prepared by the Naval Oceanographic Office, the National Ocean Survey (formerly Coast and Geodetic Survey), the British Admiralty, or by other agencies. Whatever the source, all charts used by the Navy are issued by the Oceanographic Office.

Navigation Charts

A navigational chart is one on which standard symbols, figures, and abbreviations give information on depth of water, character of bottom and shore, location of navigational aids, and other information used in actual navigation.

General sailing charts are small-scale charts showing the approaches to large areas of the coast. These charts show offshore soundings, principal lights and outer buoys, and any natural landmarks visible at a great distance The scale of general sailing charts usually is from 1 600,000 and smaller.

Coastal charts are on a larger scale They are used to navigate a vessel that is well offshore but whose position may be determined by prominent landmarks and lights, outer buoys, or soundings When navigating inside outlying reefs or shoals, or well offshore in large bays or sizable inland waterways, a coastal or harbor chart may be used.

Harbor charts are on scales larger than 1 50,000. They show harbors and their approaches in detail.

Soundings

On the watery area of any navigational chart are many tiny figures. Each number represents the depth of water (usually the depth of mean low water) in that locality Depths on some charts are given in feet, on others, they are in

fathoms. A notation under the title of the chart is the key For example, "Soundings in feet at mean low water," or "Soundings in fathoms at ....". Most charts also contain dotted lines called fathom curves. These mark the limits of areas of certain depths. On the chart in figure (E-11) you can see a 10-fathom (60 feet) curve and a 15-fathom (90 feet) curve.

Aids to Navigation

Aids to navigation are shown on a chart by symbols. Some of these can be seen in Figure E-11, which is only part of a much larger chart. As much information as possible is printed in standard abbreviation near the symbol. For instance, look at the light on Castle Hill, on the west point of Newport Neck. Printed near the light symbol is this information: Occ R 4 sec 40 ft 12M. This means the light is red, that it is occulting (the period of light is equal to or greater than the period of darkness), the period required for the light to go through a complete cycle is 4 seconds, the light is 40 feet above mean high water, and is visible for 12 miles. By "visible" is meant visible on a clear, dark night.

The chart symbol for a buoy is a diamond shape. Notice there is a small dot near every buoy symbol. This dot represents the buoy's exact location. The diamond shape itself is not drawn to scale, and may be set down considerably off the buoy's actual position.

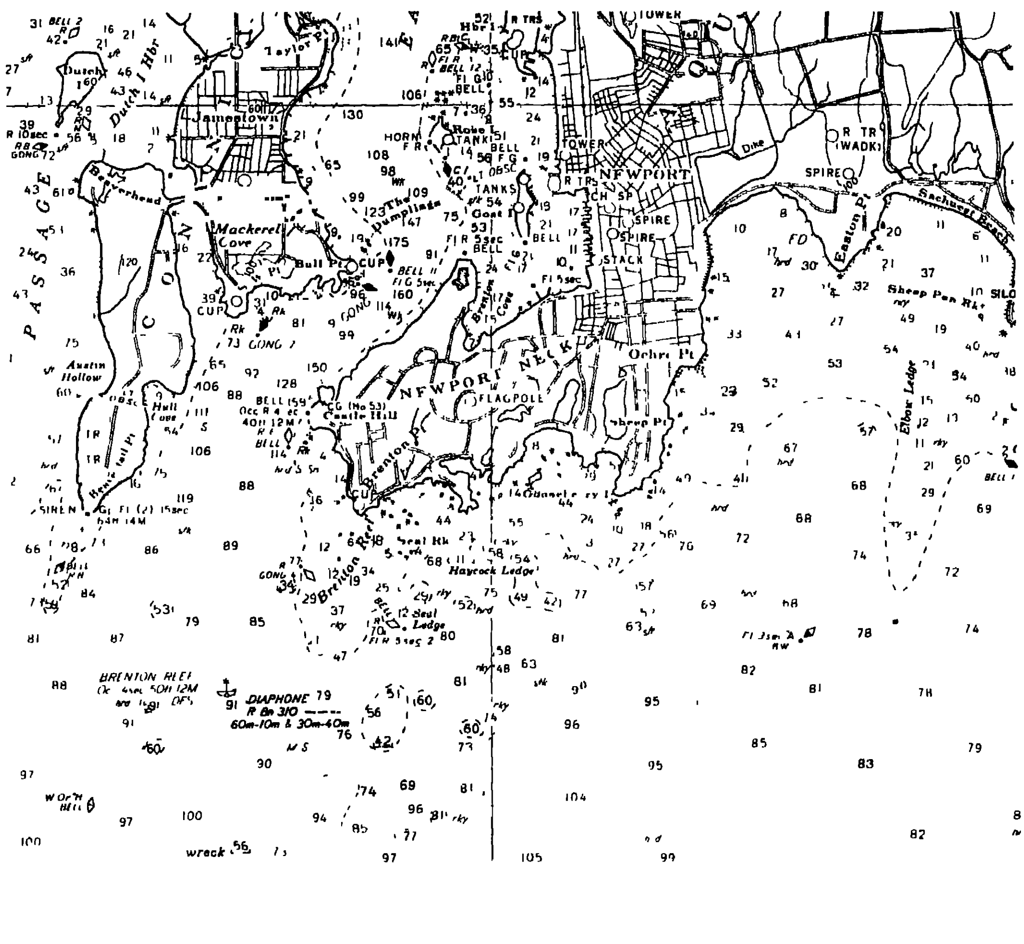

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Figure E-11.–Part of C. & G.S. Chart 1210.

CHART NUMBERS

The Naval Oceanographic Office has a chart numbering system which provides a simple method of identifying each chart by number. This indicates the geographical region and scale range in which the chart falls. Charts are numbered with one to five digits, as shown in the following lists.

Number of Digits	Natural Scale
ONE(1-9)	No scale involved
TWO(10-99)	1.9,000,001 and smaller
THREE (100-999)	1 2,000,001 to 1.9,000,000
FOUR (5000-9999)	Nonnavigational type
FIVE (11000-99999)	1.2,000,000 and larger

Under this system a prefix (N.O.) representing the Naval Oceanographic Office is used with one-, two-, three-, four-, or five digit numbers. From the list indicating number of digits and associated scale, four categories of charts exist. Each category contains clues to the location and scale range of the chart.

The first category contains charts with a one-digit number, having no scale, such as Nautical Chart Symbols and Abbreviations (N.O 1), National Flags and Ensigns (N O.5), International Flags and Pennants with Morse Symbols (N.O 6)

The second category has charts with two- and three-digit numbers that are general charts based on the nine "ocean basin" concept. (See fig. E-12.) The ocean basins of the world are as follows

Basin	Area
1	North Atlantic
2	South Atlantic
3	Mediterranean
4	Caribbean
5	North Pacific Ocean
6	South Pacific Ocean
7	Indian Ocean
8	Arctic Ocean
9	Antarctica

The first digit in the category denotes the ocean basin which the chart covers. For example, chart N.O. 15 covers the North Atlantic Ocean with a scale 1·9,000,001 and smaller. Chart N O. 121 covers the North Atlantic Ocean (northern sheet) with a scale between 1·2,000,001 and 1 9,000,000. An exception to the scale concept is the series of position plotting sheets, which have a scale larger than 1:2,000,000. These plotting sheets have been included in the three-digit number category because they cover ocean basins of 360° of longitude. Since the Mediterranean (basin 3), the Caribbean (basin 4), and the Indian Ocean (basin 7), for example, are small in size, an exception to the ocean basin concept exists. There is no chart smaller in scale than 1 9,000,000 in these areas The two-digit numbers 30 to 49 and 70 to 79 are used for special world charts that cannot have the first digit indicating an ocean basin, such as The Magnetic Inclination or Dip for the Year 1965 (N.O. 30), Magnetic Variation Chart of the World for the Year 1965 (N.O. 42), and the Standard Time Zone Chart of the World (N O. 76).

The third category consists of charts with four-digit numbers, that are nonnavigational They are a special-purpose chart series such as chart N.O. 5006, Chart of the World, Longitude 172" W to 15° E, and chart N O. 5090, Maneuvering Board (Small, in pads of 50)

The fourth category contains charts with five-digit numbers Since the charts in this category have a scale range of 1:2,000,000 and

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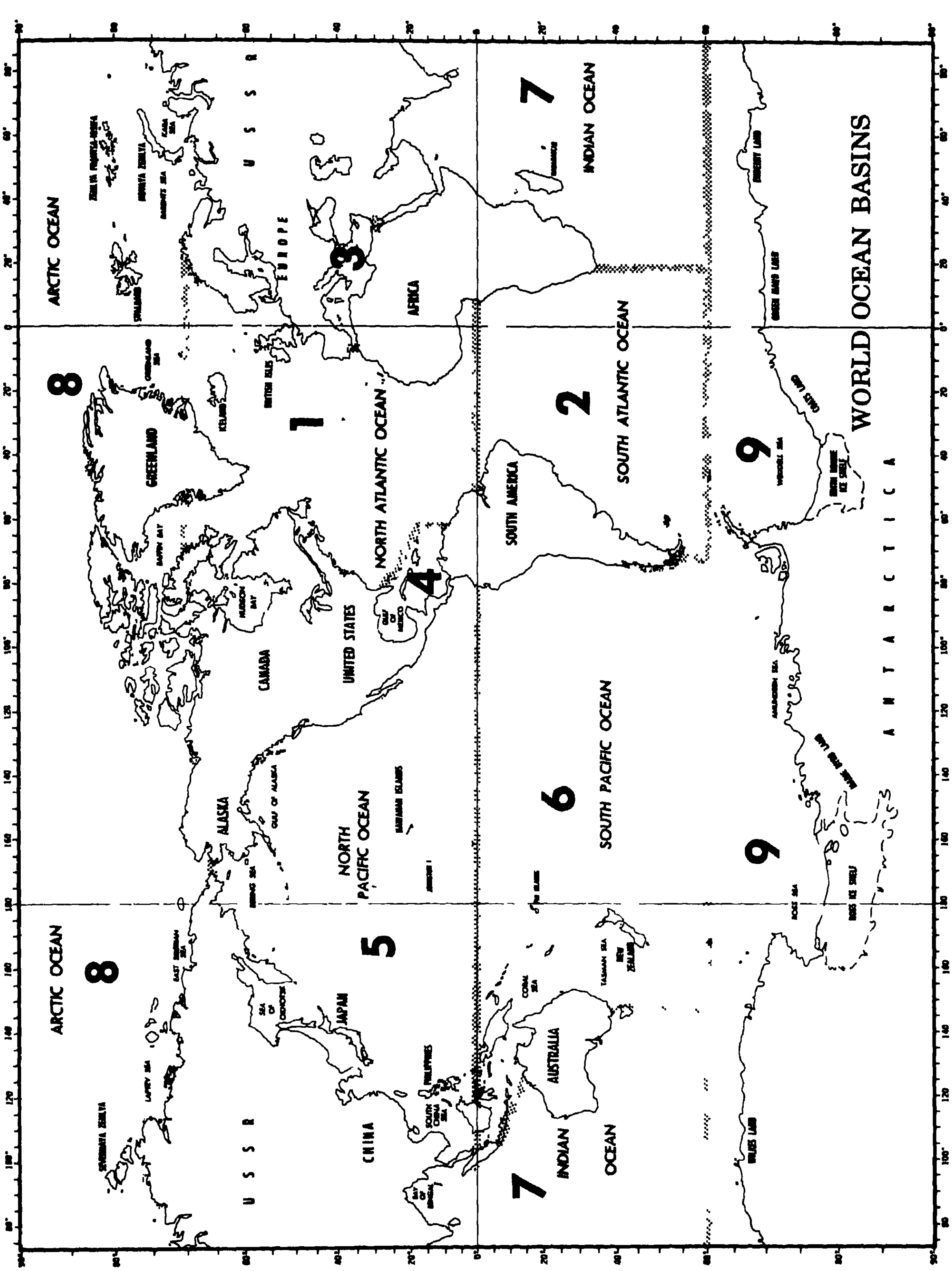

Figure E-12.–World ocean basins.

larger, the "ocean basin" concept loses significance. So another system was adopted based on the world now divided into nine regions, listed as follows:

Region	General Area
1	United States and Canada
2	Central and South America and Antarctica
3	Western Europe, Iceland, Greenland and the Arctic
4	Scandinavia, Baltic and U.S.S.R.
5	West Africa and the Mediterranean
6	Indian Ocean
7	Australia, Indonesia and New Zealand
8	Oceania
9	East Asia

Each region is further subdivided into numbered subregions. The subregions divide the world into 52 geographical areas which are assigned a two-digit designator. (See fig. E-13.)

NAVIGATIONAL INSTRUMENTS

To determine the ship's position, a navigator needs certain instruments Correct use of these instruments require both skill and experience.

Navigational instruments must have great accuracy. The chronometer, for example, is one of the most exact mechanical timepieces made by man. Another navigational instrument, the sextant, measures angles (usually altitude) with great accuracy. It goes with all navigational instruments used in the Navy. This chapter describes a number of the important navigational instruments found aboard ship.

SEXTANT

One of the better known navigational instruments is the sextant. It is used to measure angles that result in determining the ship's location at sea. The sextant is capable of measuring only the angle between two objects Its principal function in navigation is measuring the angle (called altitude here) between a heavenly body and the visible horizon. When you have the altitude, you still must work out the ship's position.

Figure E-14 shows the parts of a marine sextant. Part A is the frame on which the other parts are mounted. Part B is the limb, graduated in degrees. (The word "sextant" is derived from the Latin word Sex, meaning six. In old-fashioned sextants, the limb was one-sixth of the arc of a circle. The limb on a modern sextant contains more than one-sixth of the arc of a circle.) Part C is the index arm which pivots about the exact center of curvature of the limb. The lower end of the arm is provided with an index mark (to indicate the reading) and with a micrometer (D). The index mirror (E) is mounted at a right angle to the plane of the limb, at the upper end of the index arm. Half of the horizon glass (F) is silvered over like a mirror; the other half is clear. At zero reading the horizon glass is supposed to be exactly parallel to the index mirror. The telescope (G) is supported in a collar attached to the frame. It directs the observer's line of sight to the horizon glass in a line parallel to the plane of the frame. It also magnifies the horizon. Filters reduce the glare of light reaching the eye The colored glass filters shown in figure E-14 are being replaced by variable density polarizing filters.

MICROMETER

Figure E-15 shows you the micrometer arrangement on a sextant The limb on this sextant has teeth that mesh with teeth on the micrometer drum. One complete rotation of the drum moves the index arm 1° along the limb.

Now look at figure E-15, and see if you can figure out how to read the altitude On this type of sextant, altitude can be read to the nearest tenth of a minute. It is easy to see that the altitude is somewhere between 58° and 59°—the indicator on the arm shows you that on the main scale. Inboard of the tangent screw is the micrometer drum, graduated from 0 to 60. Each graduation represents 1 minute (1'). A smaller cylinder, inboard of the drum, is graduated from

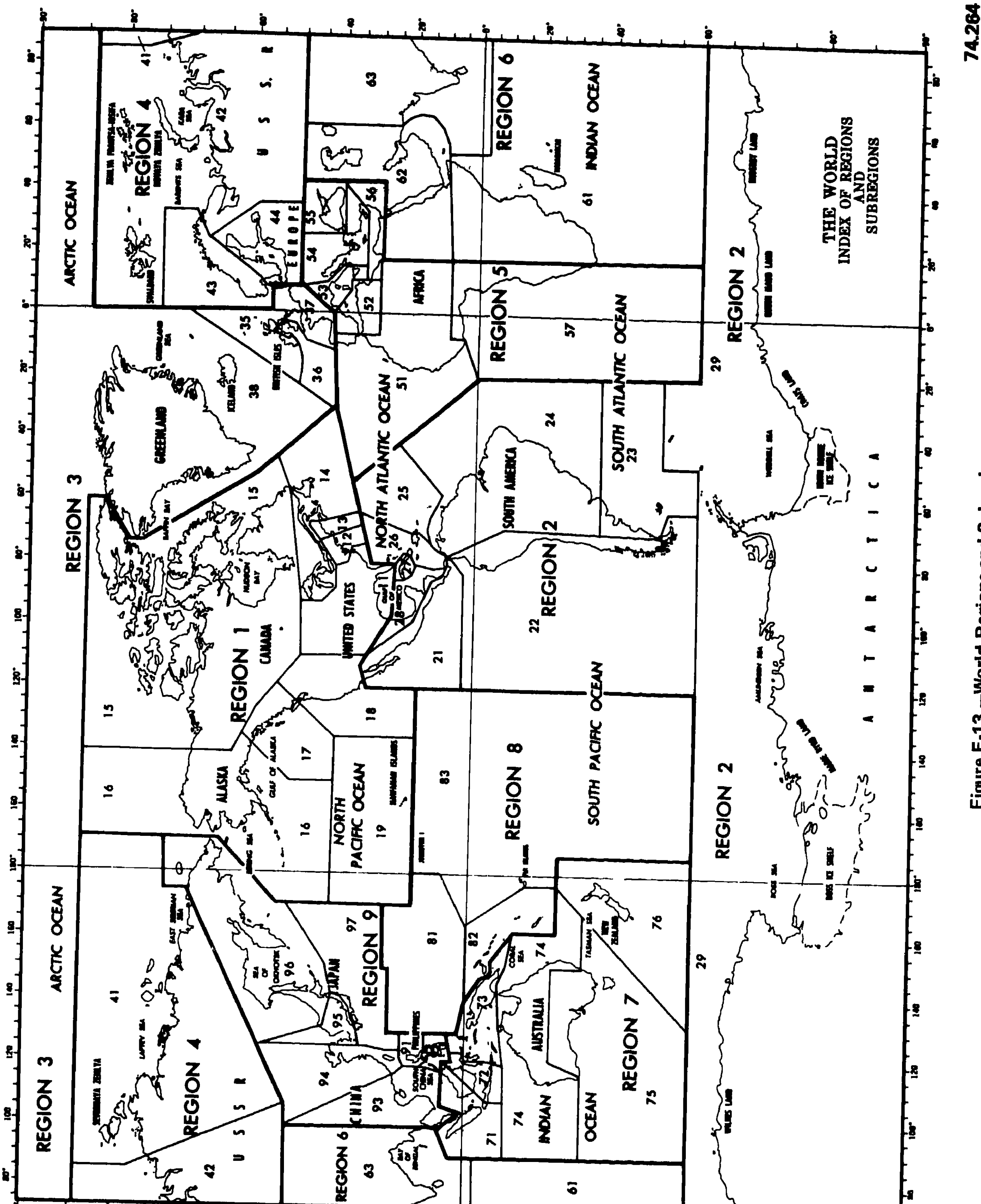

Figure E-13.—World Regions and Subregions.

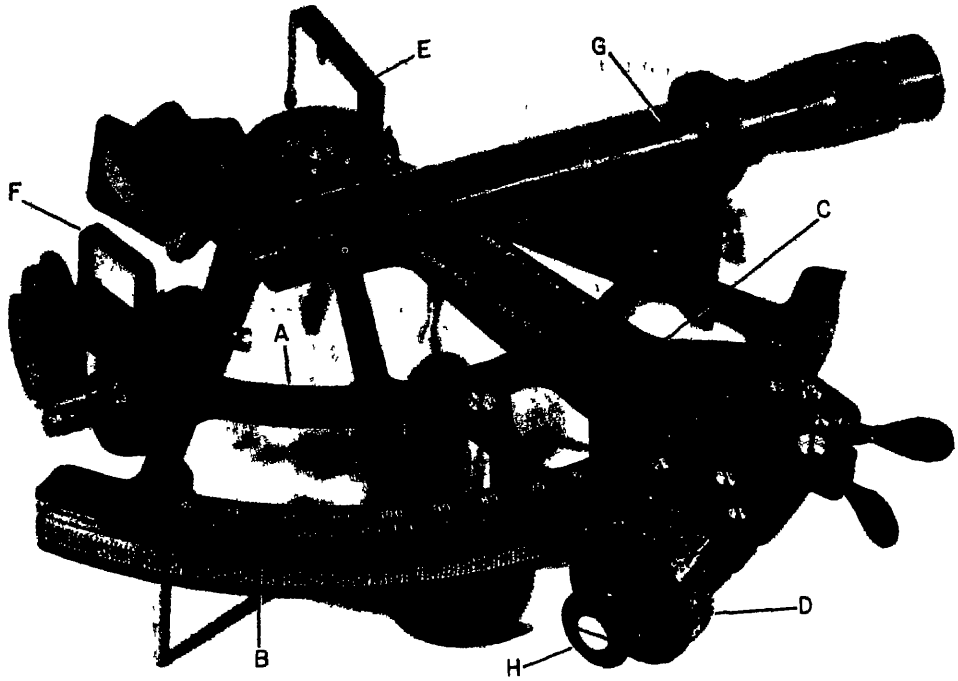

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Figure E-14.—Marine sextant.

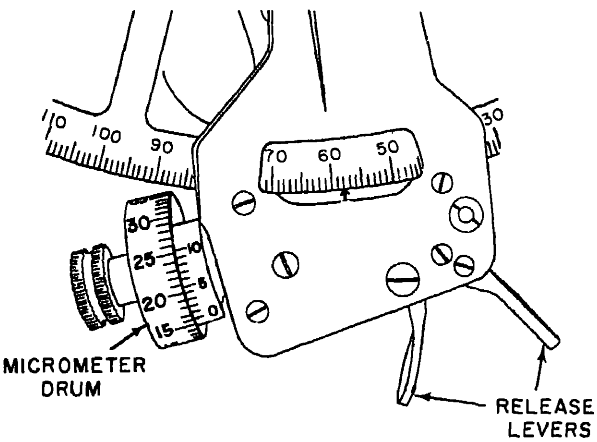

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Figure E-15.—Marine sextant micrometer.

0 to 10. It is the vernier on this type of sextant. Each graduation on it represents one-tenth of a minute (0.1′) The index mark for the drum is the 0 on the vernier, which, in figure E-15, is between 16 and 17. Thus, the altitude is a little more than 58°16′. To find out how much more the altitude is, start along the vernier scale from 0 and locate the first time that lines up with a time on the drum. Here, you can see the first graduation that lines up is 3. Therefore, the sextant shows an altitude of 58°16.3′.

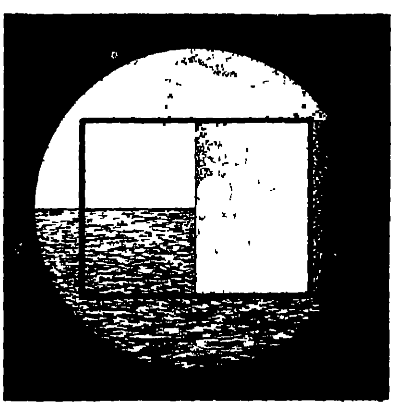
TAKING A SIGHT

Now that you know the parts for the sextant, take a sun sight and obtain an altitude. Face the spot on the horizon just below the sun. Place filters across the horizon glass and the index mirror, and look into the telescope. Move the sextant up or down until the line of the horizon crosses the middle of the clear half of

the horizon glass. Move the arm until the index mirror picks up the sun's image and reflects it upon the mirrored half of the horizon glass. Continue moving the arm so as to "pull down" the sun's reflected lower limb (lower edge of the disk) until it appears to just touch the horizon, as seen through the clear half of the horizon glass. Then rock the sextant slightly from side to side so the sun's image describes a small arc. Adjust the arm so the lower limb barely touches the horizon when the sun is at the bottom of the arc. This procedure is called "swinging the arc." It ensures that you pull the sun's reflection to a point on the horizon directly below the sun itself. Pulling it down to a point slightly to either side gives you an inaccurate altitude. Use the micrometer to obtain a fine adjustment and for reading the altitude to the nearest tenth of a minute. The view should appear much like figure E-16 at the time of observation.

TIMING OBSERVATIONS

The sextant in figure E-14 shows that the altitude of this particular heavenly body was 58°16.3′ at the instant the observation was taken. If you do not know the exact time, to the second, all your calculations will be off. The exact time of every observation must be recorded the instant the observation is made. Do not wait to read the sextant altitude first.



69.19

Figure E-16.—View through the telescope at the instant of observation.

INDEX CORRECTION

Practically every sextant has a small error, called the index error. This is allowed for by applying the index correction (IC) to every sextant reading. To find the IC, place the index mark at 0° on the limb scale. Level the sextant toward the horizon. If there were no IC, setting for zero altitude would bring the direct and reflected images of the horizon exactly into line. If the two images are not exactly in line when the instrument is set at zero, the IC is the amount shown to the right or left of zero after they are brought into line. A few graduations have been inserted to the right of the 0° mark to allow for an IC that might occur on that side.

After the images are lined up, if the index lies to the right of 0°, then the IC is plus, and must be added to all sextant readings. If the index lies to the left, the IC is minus, and must be subtracted.

This little jingle will help you remember how to apply index correction to the sextant reading: "When it's on, it's off, when it's off, it's on." In other words, when the reading is on the drum scale, the correction is subtractive, when the reading is off the drum scale, the correction is additive.

CARE OF SEXTANT

Accuracy of the sextant depends on exact adjustment of its various parts. A slight shock can disturb the adjustment enough to produce error. In handling the sextant, great care must be taken to avoid striking it against any object Accidental dropping will probably destroy its value as a navigational instrument. It should be protected against exposure to salt spray while you are waiting to get a sight If no shelter is available, a towel should be used to protect the sextant.

Moisture must not be permitted to get on the mirror or glass surface. These surfaces should be dried with a good grade of lens paper or a piece of clean, soft linen Silk or chamois may scratch the mirrors, and cotton cloth may leave particles of lint adhering to the glass. Alcohol is an excellent glass cleaner, and is safe to use on a sextant.

Never use brass polish on the arc or vernier, because it eventually abrades the marks on the scale. When cleaning becomes necessary, use ammonia. Subsequent rubbing with thin oil and lampblack will restore the distinctness of faded markings. A drop or two of light oil should be applied occasionally to the sextant's working parts.

Adjusting screws on the sextant should never be moved unless absolutely necessary, and then only by authorized persons, who must exercise the greatest possible caution. Minor adjustments are described in both Dutton's Navigation and Piloting and Bowditch's American Practical Navigator. All other adjustments should be made by trained personnel in the optical shop.

AIDS TO NAVIGATION

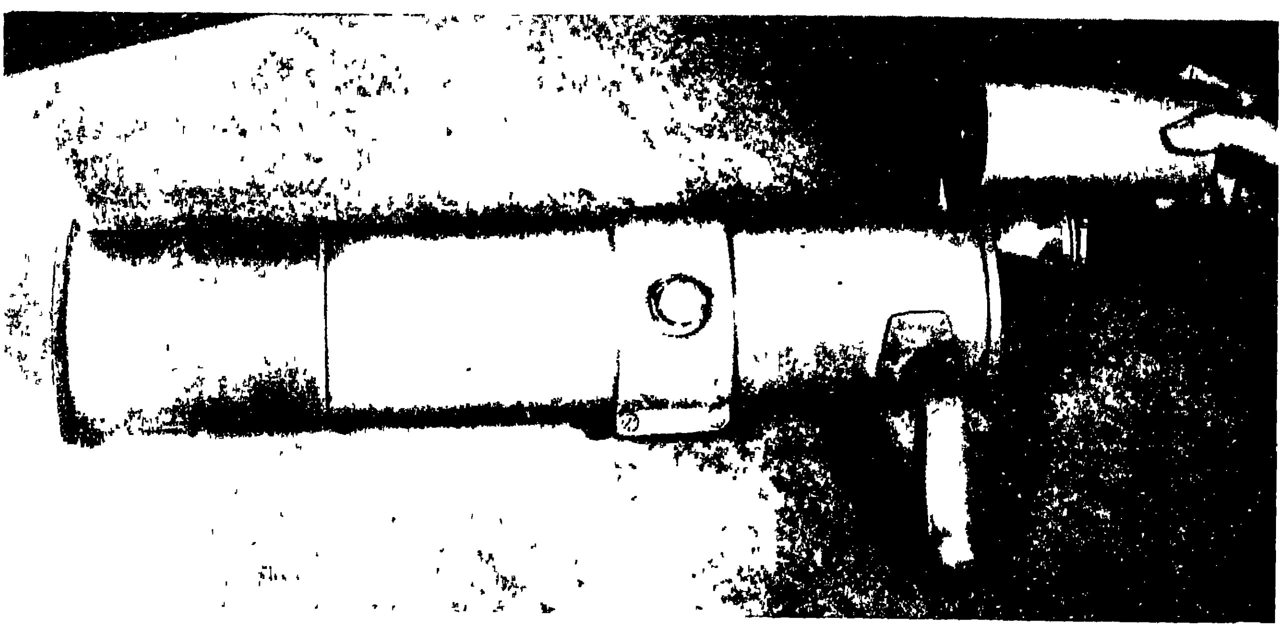
Onboard ship, defective vision, if corrected by glasses, is not especially detrimental to the adequate performance of duty. To the Quartermaster, who spends much of his time looking for and observing distant objects and landmarks, however, good vision is a basic requirement. In order to magnify distant objects, the important aids to vision, described in the following four topics, are carried on nearly every ship.

SHIP'S TELESCOPE

The ship's telescope (fig. E-17) is a variable power instrument. Four separate eyepieces are provided so that the eyepiece magnification power may be 13, 21, 25, or 32. That is, an object may be magnified for the naked eye 13, 21, 25, or 32 times its apparent size. The telescope is mounted in a yoke that permits 360° of horizontal rotation. When actually viewing, both eyes may be kept open if this procedure is more convenient for the viewer. The unoccupied eye should, however, always be closed while the focus is being adjusted. The ship's telescope is useful in spotting flaghoists and other signals.

LONG GLASS

Two types of long glasses are used aboard ship. In the old sailing men-of-war, the OOD



37.2

Figure E-17.—Ship's telescope

never "kept the quarterdeck" without the long glass tucked under his arm. Whether he wanted to train on anything or not, it was customary for him to carry it. It is available for seeing objects out of range of hand-held binoculars but not distant enough to require use of the ship's telescope or ship's binoculars. The custom of carrying it when underway, however, has been discarded. In port, it still is carried by the OOD on the quarterdeck. The strength of the OOD long glass is 10 power.

Besides the OOD long glass, there is the Quartermaster's long glass (fig. E-18). This glass is 16 power. It generally is used by a Signalman or Quartermaster for reading flags and observing distant objects when the magnifying power of hand-held binoculars is inadequate. Both the OOD long glass and the QM long glass must be supported on a steady object, otherwise it is difficult to focus on a target. As with the ship's telescope, it is necessary to keep one eye closed while focusing, but both may be open while actually viewing.

Be careful not to lean over the side when training any telescope, you might drop it.

HAND-HELD BINOCULARS

The word binoculars consists basically of two Latin words spliced together bini (two at a time), and oculus (eye). You use both eyes at a time. The chief advantage is a wider field of observation.

Hand-held binoculars (fig. E-19) are usually only about 7 power. There is a tube for each eye, and because both eyes do not always have the same vision, it is best to adjust the focus individually for each eye. The glass used in most binoculars is treated to reduce glare. Additional colored filters are provided for use when the view is bright. It is best not to use the colored filters unless their use is absolutely necessary. This is because they reduce visibility, and the eye becomes accustomed to them. Individual ability in detection can be improved by resting the body, elbow, or even the binoculars on some firm support.

Wearing eyeguards aids in shielding the user's eyes from light. Placing objective guards on binoculars helps reduce damage to the binoculars.

SHIP'S BINOCULARS

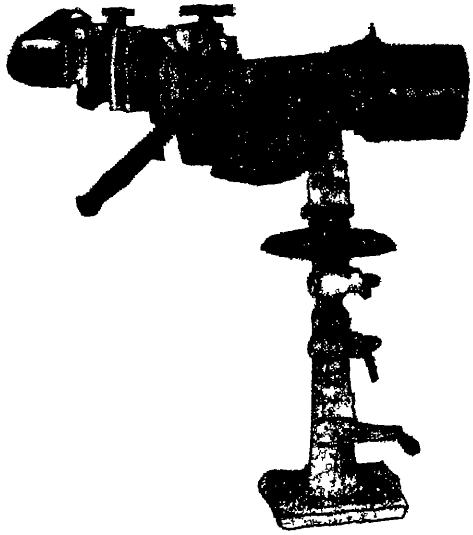
The ship's binoculars (fig. E-20) are used along with the telescope on many ships. Eyepiece magnification power of the two models in use is 20 power. Eyepieces on the older model are inclined at a 45° angle for easier

37.3(69)

Figure E-18.—Quartermaster's long glass.

37.1(69)

Figure E-19.—Hand-held 7 x 50 binoculars.



69.18

Figure E-20.—Ship binoculars.

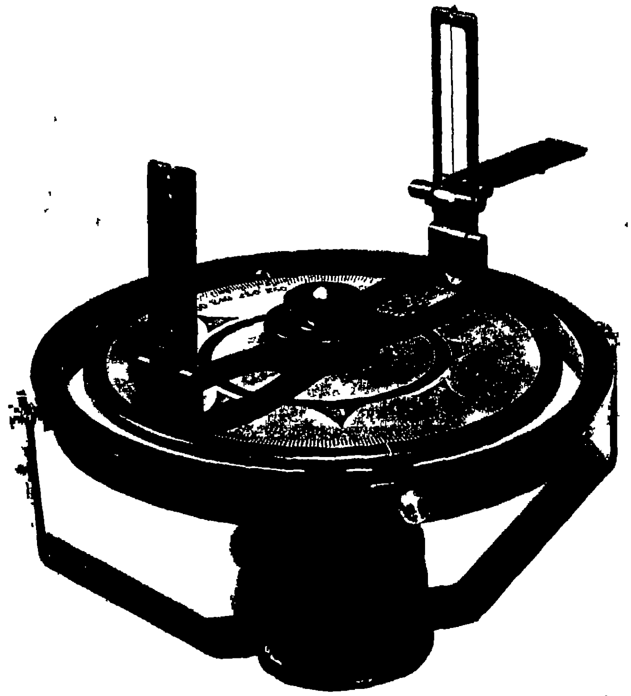
viewing. Later model binoculars have variable density polarizing filters and adjustable focusing Both binoculars are supported in yokes mounted in either bulkhead brackets or deck stands. An adjustable carriage (elevating gear) is used with the deck stand for raising or lowering of the binoculars.

PELORUS

In a ship without a gyro installation, a pelorus or dumb compass (fig. E-21) is located on either bridge wing. From here, bearings may be taken on objects visible from the ship. In pelorus stands similarly located, gyro repeaters have replaced the peloruses on all gyro-equipped ships. If the gyro should fail, a bridge wing gyro repeater usually can substitute for a pelorus.

The pelorus consists of a nonmagnetic metal ring mounted in gimbals on a pelorus stand. The inner lip of the ring is marked through 360°. The 000° mark corresponds to the ship's lubber's line.

Inside the ring is a dumb compass card. It can be rotated so as to bring any heading on the lubber's line. A pair of sighting vanes, mounted



69.20

Figure E-21.—Pelorus or "dumb compass."

on the card, is aimed to the object whose bearing is desired.

If the dumb compass card is set to the ship's true course, the bearing by pelorus will be a true bearing. This synchronization seldom happens, and it is customary for the person taking the bearing to sing out "Mark!" when it is taken. The steersman notes the compass heading when it is heard "Mark!" If the ship was on the true course, the bearing obtained was a true bearing. If she was off course, a correction equal to the amount she was off must be applied to the bearing. If the course was by magnetic compass, the bearing by pelorus must still be converted from compass to true.

Relative bearings are taken by pelorus merely by setting the dumb compass card's 000° heading to the lubber's line

The gyro repeater gives true bearings without the necessity for any compass correction or allowance for the ship's being off course. It is easy to see why gyros have peloruses.

AZIMUTH CIRCLE AND BEARING CIRCLE

Both azimuth and true bearing have the same meaning; the horizontal angle made by drawing a line from the object sighted to you and from you to the true north pole. The word azimuth is applied only to bearings of heavenly bodies. To illustrate, it is not the bearing but the azimuth of the sun, it is not the azimuth but the bearing of the Brenton Reef Lightship. (But the meaning is the same.)

A bearing circle is a nonmagnetic metal ring equipped with sighting devices. It is fitted over a gyro repeater or a magnetic compass. Normally, only bearings of objects on the earth's surface are taken with the bearing circle.

The azimuth circle is merely a bearing circle equipped with additional attachments for taking azimuths of celestial bodies. Either bearings or azimuths may be taken with the azimuth circle.

A telescopic alidade (fig. E-22) is an erecting telescope equipped with crosshair, level vial, polarizing light filter, and internal focusing. The telescope is mounted on a ring that fits on a gyro repeater or magnetic compass. The optical system projects the image of approximately 25° of the compass card, together with a view of the level vial, onto the optical axis of the telescope. By this means, both the object and its bearing can be viewed at the same time through the alidade eyepiece. Older models of the telescopic alidade have a straight-through eyepiece telescope, whereas the model shown in figure E-22 has the eyepiece inclined at an angle for ease in viewing.

SELF-SYNCHRONOUS ALIDADE

A self-synchronous alidade (fig E-23) is a motordriven instrument used to obtain accurate bearings. A synchro receiver is used to drive the telescope after it is set on a target. The synchro receiver is similar to the one that drives the compass card. It is activated by the same master gyro. A self-synchronous alidade can be set to any bearing. The receiver keeps it fixed in this true direction until it is reset. This instrument is gradually becoming obsolete, but it is still used on a few ships.

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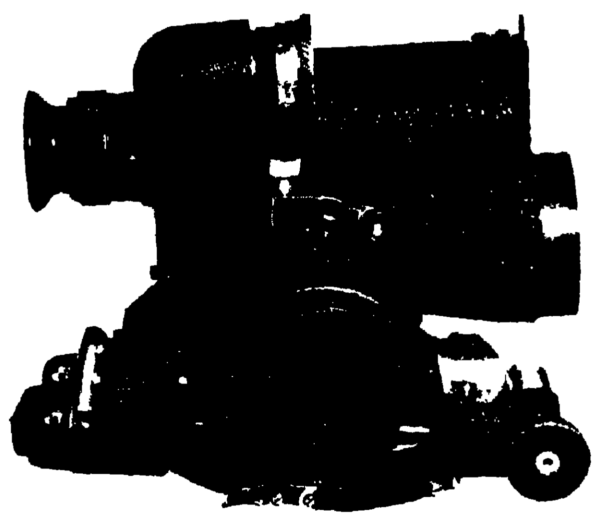
Figure E-22.—Telescopic alidade.



45.39(69)B

Figure E-23.—Self-synchronous alidade.

STADIMETER

The stadimeter is used most often to measure distances from your ship to others in a formation. In piloting, it is also used as a navigational instrument to measure distance to some navigational aid. Stadimeters are of two types: the Fisk type (fig. E-24) and the Brandon sextant type. In using either type, the height of the object whose distance is desired must be known. That height must be between 50 and 200 feet. (Usually, when measuring distances to ships, the height used is from the boot topping to the top of the mast or highest radar.) Distances are measured with good accuracy up to 2000 yards. Beyond that range the accuracy of the stadimeter decreases.

Operation of the Fisk-type stadimeter is typical of the two, because operation of the Brandon type varies from the Fisk only in minor details. Say you are trying to get the range to a 120-foot light structure. Move the carriage containing the index drum to the 120-foot mark on the index arm. Sight through the telescope at the light structure. As with the sextant, you will see a direct and a reflected image Turning the drum causes the reflected image to move up or down relative to the direct image. When the top of the reflected image is in line with the bottom of the direct image, distance in yards may be read directly from the drum.

A stadimeter is a delicate instrument, and requires the same care given a sextant

PLOTTING INSTRUMENTS

PARALLEL RULERS AND DIVIDERS

The parallel ruler is a plotting instrument consisting merely of two straightedges connected by metal strips. The two straightedges may be closed or opened, but they always remain parallel to each other. By placing the edge of one ruler along a line of bearing and "walking" the rulers across the chart to the compass rose, the true bearing of the line may be found. Figure E-25 shows you a set of parallel rulers and also a pair of dividers. In navigation, dividers are used for transfering chart distances to scales of miles.

PROTRACTOR

A protractor performs practically the same function as parallel rulers, but without the necessity for any walking across the chart. A simple protractor consists of a graduated arc on a piece of celluloid. There is an attached ruler that pivots on the center of the curvature of the arc. The Hoey position plotter is a protractor of this type. Its arc is marked like the upper half of a compass rose. Horizontal and vertical lines are etched on the celluloid. By lining up these lines with meridians or parallels, any course or bearing can be plotted by swinging the ruler to the desired degree mark on the arc.

DRAFTING MACHINE

The drafting machine (also called parallel motion protractor) (fig. E-26) consists of a protractor that is moved across the chart by a parallel-motion linkage fastened to the chart board. The linkage permits movement of the protractor to any part of the board without any change in the angles set on the protractor disk. This instrument is used for laying off courses and bearings and for transfering lines from one location to another The graduated protractor rim can be clamped to any direction on the chart.

DEAD RECKONING TRACER

At this time, you are not supposed to know much about dead reckoning The subject will be discussed later. For now, it is enough for you to know that a ship's dead reckoning position is the place she would be if she actually made good the courses steered, and she progressed exactly the distance shown on her log. This method of navigation would be fairly accurate if a ship ran on rails like a train Because the ocean has currents, the dead reckoning position must be corrected to the ship's actual position each time a fix is obtained.

The dead reckoning tracer (DRT) consists of a glass plotting board under which a moving light (called a "bug") follows the movement of the ship's dead reckoning position. (See fig E-27.) The light is mounted on the arm whose motion is controlled by the ship's gyrocompass

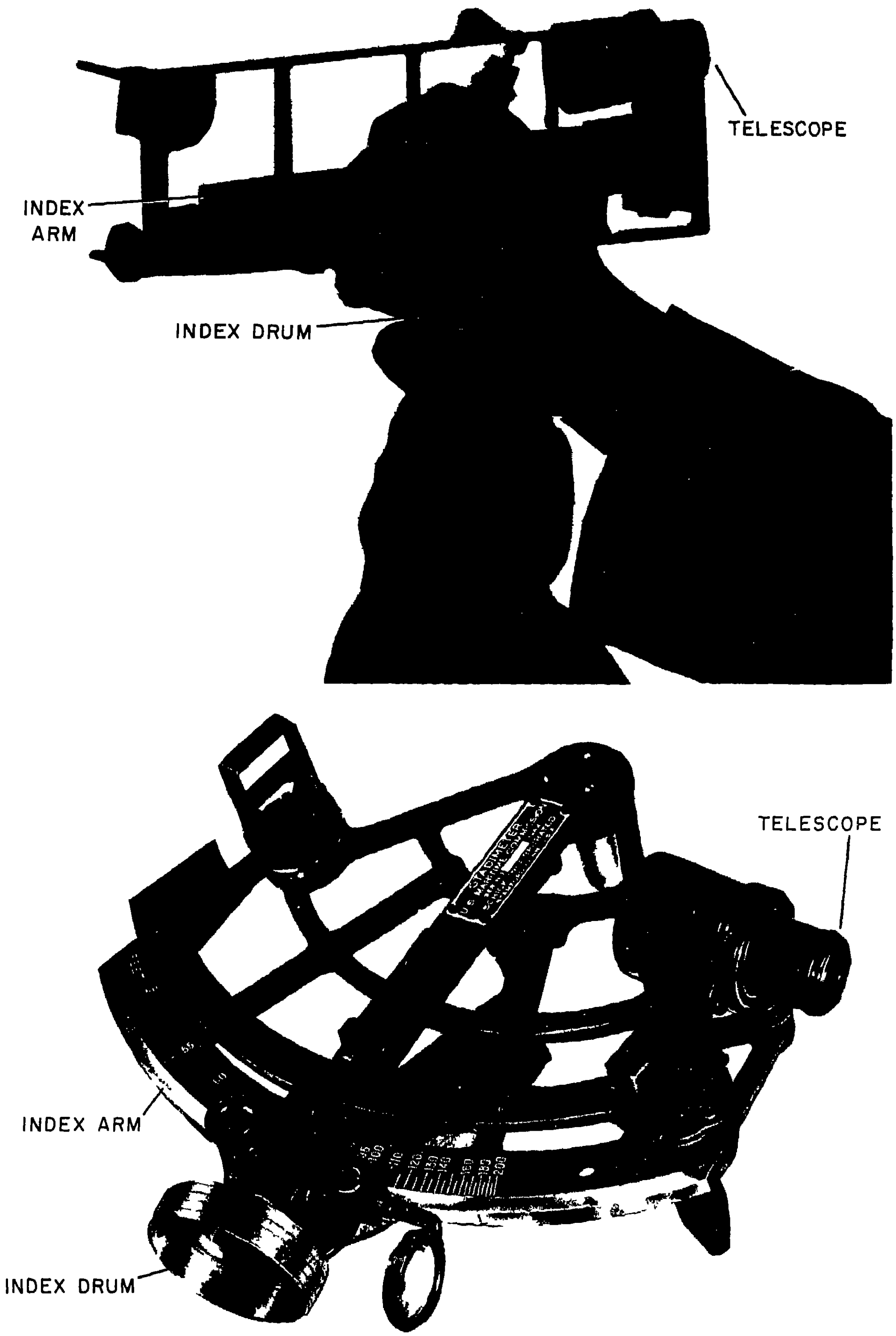


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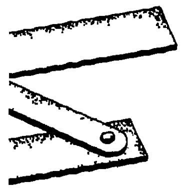
Figure E-24 –Fisk-type stadimeter.



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dividers.

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ship's own dead
purpose of the DRT is
e-minute plot of all ships
within range of your radar. Most DRT systems are equipped with drafting machines. The one shown in figure E-27 is not so equipped. Instead, it has a compass rose attachment on the bug that can be adjusted to indicate true bearings. Radar contacts on this DRT model are plotted with parallel rulers.

TIME AND TIMEPIECES

The navigator steps out on the bridge wing and takes a sight on the star Vega. After making corrections to the sextant altitude, he finds the altitude of Vega from your position at the time of observation. From tables, extract the altitude of Vega from a previously selected assumed position (AP) at the instant you took the sight. Then find (again, from tables) the azimuth of Vega from the AP. Use the difference between the altitude from your actual position and the altitude from the assumed position to calculate how far away you were from the AP at the time of observation. Measure this distance along the azimuth line, and establish a line of position.

This outline tells how a line of position is determined by celestial navigation. The reason it is given here is to impress upon you the importance of time in navigation. Suppose the navigator's observation is wrong by 1 minute. Although 1 minute is not very long, it can make a big difference in navigation. Instead of the observation time, suppose the altitude is worked out for 1 minute earlier or later. This could produce an error of as much as 15 miles in the resulting line of position. Regardless of your latitude, a 1-minute time error produces a 15-minute error in longitude. On the equator, 1 minute of longitude equals 1 nautical mile.

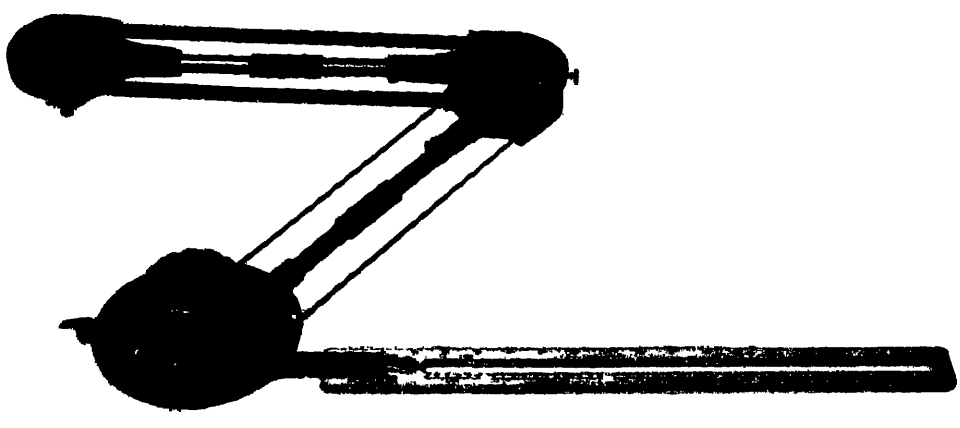

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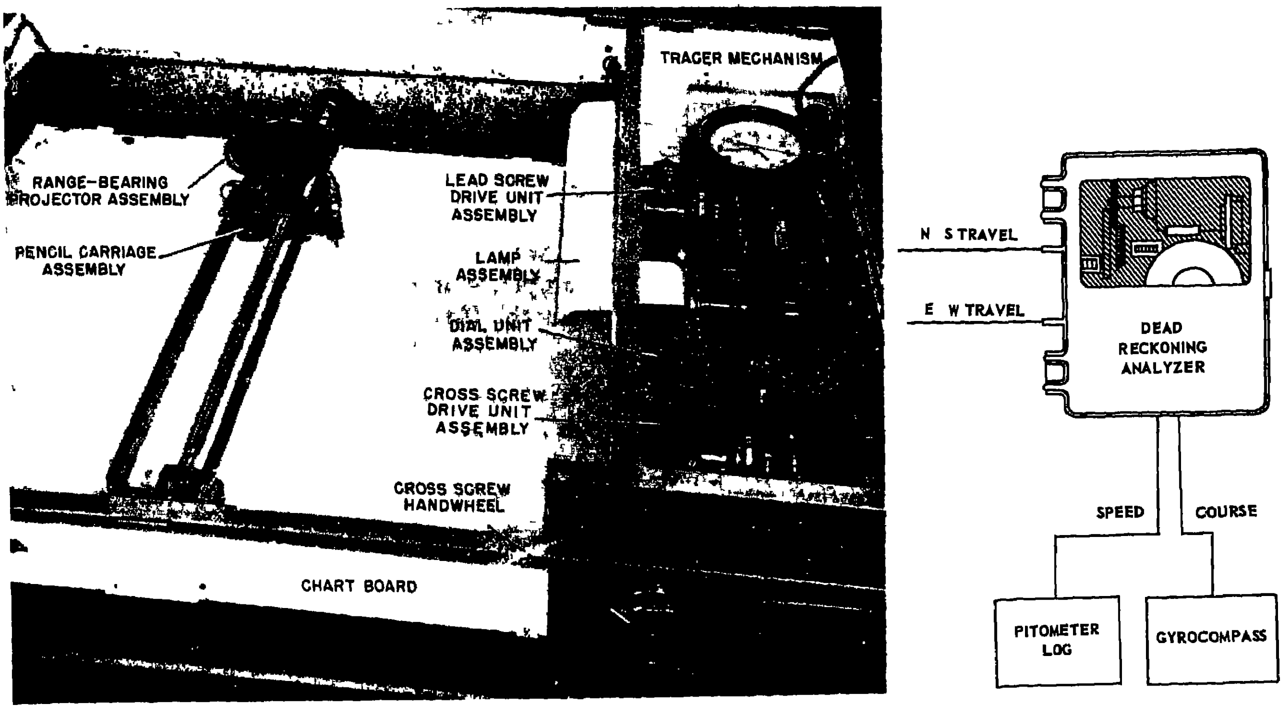
Figure E-26.—Drafting machine.



40.61

Figure E-27.—Dead reckoning tracer.

You know that the motion of the sun and the stars around the earth is only apparent. It is an illusion created by the rotation of the earth itself. In the discussion of time, it is simpler to consider the heavenly bodies as moving around the earth

TIME AND ARC

We use solar time, which is measured by the motion of the sun around the earth. If you are standing on the main deck aft of a ship headed due north and the sun passes your given meridian (your longitude) it is noon where you are at that time, but if the ship were headed due east, noon would occur on the forecastle before it would occur at your after location.

Every celestial observation is timed according to the time at the Greenwich meridian. Usually, timing is determined by means of the chronometer, which is set to Greenwich time In order to clarify the relationship between time and arc, let's say that it is exactly noon where you are You know your longitude, and you want to find what time it is in Greenwich

The sun makes a complete 360° revolution around the earth every 24 hours (h). When the sun is on a given meridian, it is noon along that meridian. In other words, when the sun is on the Greenwich meridian (0°), it is noon by Greenwich time. Say you are in 90°W. longitude. It is noon where you are, so the sun also is 90°W Since leaving Greenwich, the sun traveled through 90° of arc Because it was 1200 Greenwich time when the sun was at 0°, the time at Greenwich now must be 1200 plus the time required for the sun to travel through 90° of arc.

This explanation provides all the elements of a problem for converting arc to time If you know that it takes 24h for the sun to travel 360°, it should be a cinch to find how long is

required for it to go 90°. If it travels 360° in 24h, it must go 15° in 1h. If it transits 15° in 1h, it must go 1° in 4 minutes (m). To go 90° requires 90 multiplied by 4m, or 360m, which is 6h. Six hours ago it was 1200 Greenwich time. Therefore, the time at Greenwich now must be 1800. You actually have converted 90° of arc to 6h of time. You also discovered the basic relationship between arc and time. This relationship is stated as 15° of longitude (arc) equals 1 hour of time.

You can also convert time to arc—the reverse of the example just worked. Tables for converting either way are in the *Nautical Almanac* and in Bowditch. But if you learn the following easy methods of converting, you will not have to refer to other sources. First, you must memorize the values for arc and time in the accompanying table. The only reason you need to memorize these values is to make it easier to remember the methods for converting arc and time.

Arc and Time Equivalents

Time to Arc		Arc to Time	
24h	360°	360°	24h
1h	15°	1°	4m
1m	15′	1′	4s
1s	15″		

METHODS FOR CONVERTING TIME AND ARC

Time to arc Suppose you want to change the time 10h 15m 10s to its equivalent in arc. First, arrange the figures in a column, with the degree, minute, and second symbols of arc measurement in a row alongside, as follows

	°	′	″
10h	--	--	--
15m	--	--	--
10s	--	--	--

The next part is easy. There are 15° in 1 hour, so multiply the hours by 15.

	°	′	″
10h	150	--	--
15m	--	--	--
10s	--	--	--

Next, divide the minutes by 4. In this example, 4 into 15 is 3, with a remainder of 3. Write the first 3 under degrees.

	°	′	″
10h	150	--	--
15m	3	--	--
10s	--	--	--

Now, multiply the remainder, 3, by 15, which gives you 45. This number goes under minutes.

	°	′	″
10h	150	--	--
15m	3	45	--
10s	--	--	--

To convert seconds, follow the same procedure, divide them by 4. Here you divide 4 into 10, which gives 2 and a remainder of 2. Write the first 2 under minutes and multiply the remainder, 2, by 15 This procedure gives you 30 seconds. You now have these totals

	°	′	″
10h	150	--	--
15m	3	45	--
10s	--	2	30
	153	47	30

Thus, in 10h 15m 10s of time, there are 153° 47′ 30″ of arc.

Arc to time Now convert the other way—from arc to time. Set up the degrees, minutes, and seconds of arc just as you did the hours, minutes, and seconds of time.

	h	m	s
153°	--	--	--
47′	--	--	--
30″	--	--	--

An hour contains 15°, so divide the degrees by 15. This result is 10, with a remainder of 3. Write 10 under the hours column.

	h	m	s
153°	10	--	--
47′	--	--	--
30″	--	--	--

Multiply the remainder, 3, by 4, and put the resulting 12 in the minutes column.

	h	m	s
153°	10	12	--
47′	--	--	--
30″	--	--	--

Next, divide the minutes by 15, which gives you 3 and a remainder of 2. Place 3 under minutes, multiply 2 by 4, and write the product, 8, under seconds.

	h	m	s
153°	10	12	--
47′	--	3	8
30″	--	--	--

Divide the seconds also by 15. This step gives you exactly 2, with no remainder. Write the 2 under seconds. This entry completes the conversion of arc to its equivalent in time, thus

	h	m	s
153°	10	12	--
47′	--	3	8
30″	--	--	2
	10	15	10

KINDS OF TIME

Astronomy provides the basis for measuring time. A day is measured as one rotation of the earth about its axis. The point from which rotation is measured determines the type of time considered–solar, sidereal, or lunar. Apparent time and mean time are applied in certain problems of navigation. The difference between apparent and mean time is called equation of time.

APPARENT TIME

The sun is our most convenient reference point for reckoning time. Time measured by the sun is called solar time. Rotation of the earth on its axis produces apparent motion of the sun around it. When we measure time by the apparent motion of the sun, we call it apparent time. If the sun is directly over the meridian we are on, we say that it is noon, local apparent time. When it is directly over the meridian 180° away from ours, it is midnight, local apparent time.

If the earth remained fixed in space, all the days reckoned by apparent time would be the same length. But the earth travels around the sun, and its speed relative to the sun varies with its position. Consequently, the time required for a complete rotation of the earth on its axis varies regarding the earth relative to the sun. Therefore, the length of a day reckoned by a complete rotation of the earth with regard to the sun, also varies.

MEAN TIME

It would be rather confusing if some days had more and some fewer hours to conform to the irregularities of the earth's rotation. To preserve the obvious advantages of solar time, yet eliminate these irregularities, solar time used in navigation is mean time. It is calculated from the motion around the earth of an imaginary mean sun, which always makes the 360° trip around in exactly 24 hours. When it is noon by local mean time (LMT) the mean sun, instead of the true sun, is exactly over your meridian

Four times a year the positions of the mean and the true sun are the same. On those four occasions there is no difference between apparent and mean time. Otherwise, there always is a difference, called the equation of time, which is listed in the *Nautical Almanac* for every 12 hours of Greenwich mean time (GMT) of the sun on any date. The equation of time reaches a maximum of nearly 16 1/2 minutes.

SOLAR, SIDEREAL, AND LUNAR TIME

Solar time is calculated from the motion of the sun around the earth. Solar time is the principal time used in navigation.

Sidereal time is calculated from the motion of the stars around the earth; it is used in the procedure for identifying heavenly bodies. For the present, all you need to know about sidereal time is that it is measured by the motion around the earth of the first point of Aries. A sidereal day is about 4 minutes shorter than a mean solar day, and there are 366 1/4 sidereal days in a calendar year.

A lunar day is measured by the motion of the moon as it orbits the earth. It is about 50 minutes longer than a mean solar day. Moon data is used in some navigation problems and in tide analysis.

ZONE (STANDARD) TIME

We have seen that local mean time always differs in different longitudes. In New York City, for example, a difference of about 9s LMT occurs between one end of Forty-second Street and the other end.

You can understand, now, how a general-foulup would result if everyone's watch was set on his own LMT. You would have to change it every time you went a few blocks on a street running east and west. To eliminate this difficulty, standard time zones have been established, within which all clocks are set to the same time. A difference of 1 hour takes place between one time zone and the next. Because 1h is 15°, you can see that each time zone covers 15° of longitude.

The standard time zones begin at the Greenwich meridian (0°). Every meridian east and west of Greenwich that is a multiple of 15° (15°, 30°, 45°, 60°, 75°, and so on) is a standard time meridian. Each standard time meridian is at the center of its time zone. The zone extends 7°30′ (half of 15°) on either side of the meridian. Certain standard time zones ashore vary from this procedure in order to give adjacent populated areas the same time.

Local mean time along each standard time meridian is zone (standard) time for the entire time zone. Zone time in navigation is abbreviated ZT.

Daylight saving time is simple zone time set ahead 1 hour (sometimes 2 hours) to extend the time of daylight. Daylight saving time is ignored in navigation.

ZONE TIME AND GMT

GMT is the time at the Greenwich meridian, measured by the mean sun. The Greenwich meridian is the standard time meridian for the 0 time zone. Then zone time anywhere in the 0 zone is the same as GMT. Most of the information in navigational tables uses GMT, so you must know how to convert the time in any zone to GMT.

The solar day contains 24h, and each time zone represents 1h, so there must be 24 zones. Beginning with the 0 (Greenwich) zone, time zones run east and west from zone 1 to zone 12. (See fig. E-28.) Zones east of Greenwich are minus, those west of Greenwich are plus zones. (Note that +12 and -12 time zones each include only 7 1/2° of longitude.) In other words, in zones east of Greenwich, you must subtract the zone number from the zone time to find Greenwich time. In zones west of Greenwich, you must add the two. The zone time at Greenwich is GMT. The zone number tells you the difference in hours between your zone time and GMT.

Standard time zones are also designated by letters. You can find the equivalent letter designation from the numbered zone by referring to figure E-28.

Because there is a standard time meridian for every 15° of longitude, you divide your longitude by 15° to find which zone you are in. Then, to find GMT, you merely apply the zone description (ZD) according to its sign.

Assume that you are in longitude 105°E., ZT is 16h 23m 14s, and you want to find GMT. Dividing 105 by 15 yields 7, which means you are in time zone 7. You are in east longitude, so the sign is minus. Therefore, your ZD is -7. The

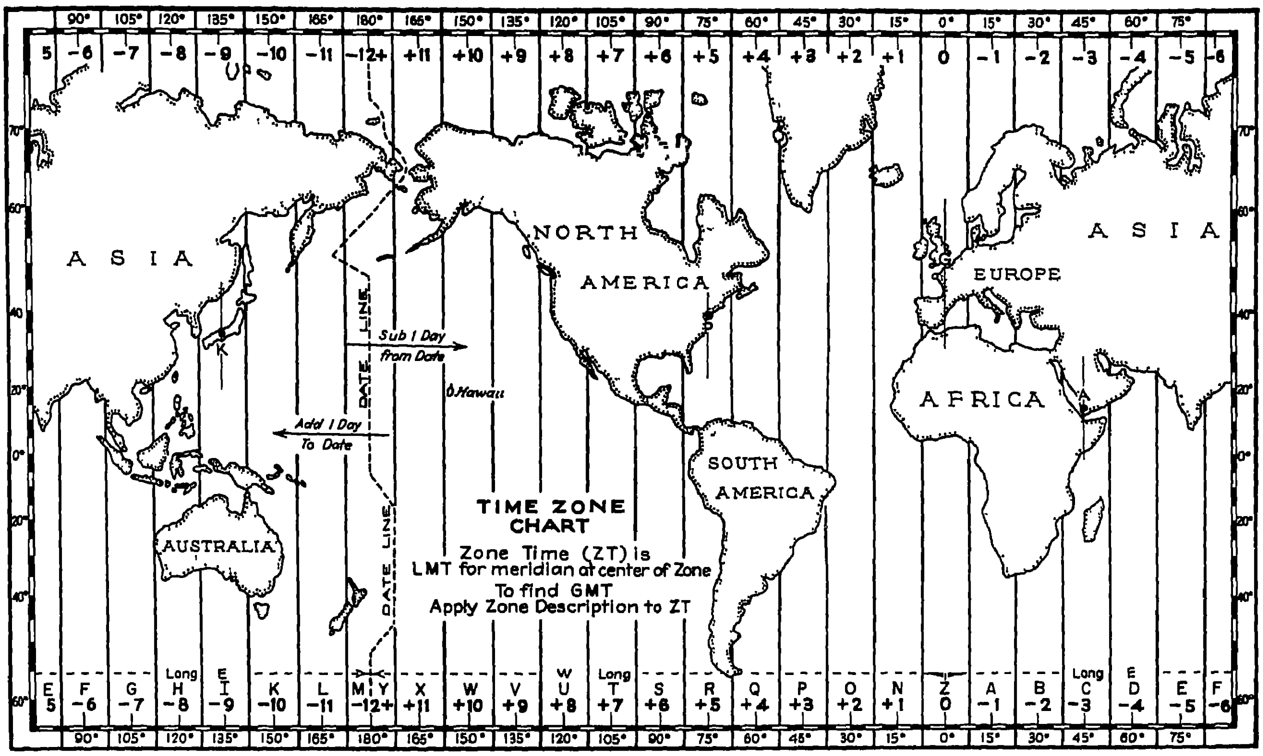


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Figure E-28.—Standard time zones.

minus sign means that you subtract ZD from ZT to find GMT Thus

ZT	16h	23m	14s
ZD	- 7		
GMT	9h	23m	14s

Or, say you're in longitude 75°W., ZT is 7h 13m 57s, and you want to find GMT. Divide 75 by 15 and your answer is 5. Therefore, you are in zone 5, and it must be plus 5, because your longitude is west. Consequently

ZT	7h	13m	57s
ZD	+5		
GMT	12h	13m	57s

In both examples, your longitude coincided with a standard time meridian which simplified the solution somewhat. If you are not located on one of these meridians, you can figure out which zone you are in by dividing your longitude by 15, and observing the size of the remainder. You must bear in mind that each standard time meridian is at the center of its time zone. The zone extends 7°30′ on either side of the meridian. For example, say your longitude is 142°41′W., and you want to know ZD. Dividing 142°41′ by 15, you have 9, with 7°41′ left over. But 7°41′ is more than 7°30′, so you must be in the zone next beyond zone 9, meaning zone 10.

TIME AND DATE

In the first diagram in figure E-29, the mean sun is over the Greenwich meridian. This means that it is noon, 1 May, GMT Because it is noon, GMT, it must be 12 hours later (midnight) at the 180th meridian on the other side of the earth. In other words, the sun is just starting its 24-hour cruise. It is the same day all the way around the

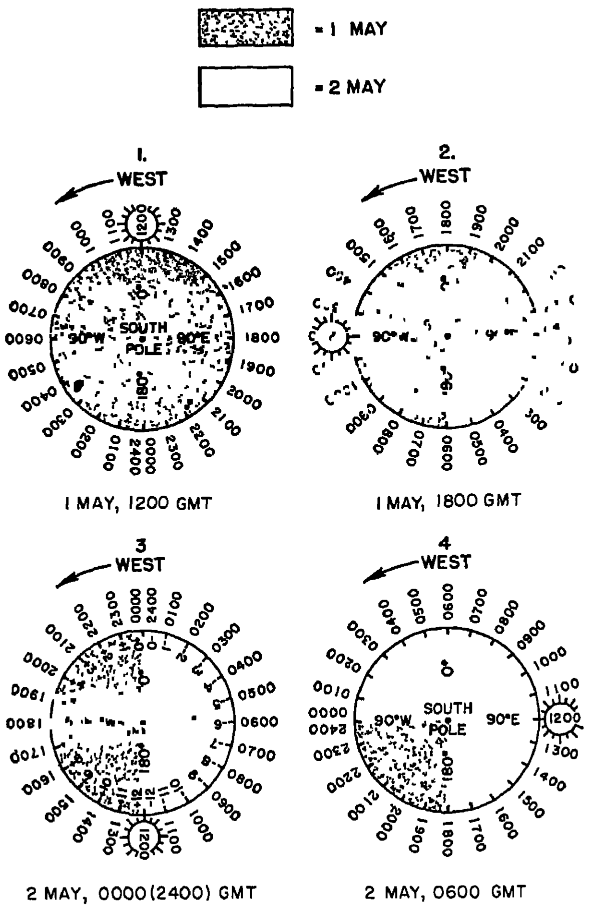

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Figure E-29.—Date change over the earth.

earth, but a new day is about to begin at the 180th meridian.

As the sun moves westward, it takes noon along with it, so to speak. Midnight moves along into east longitude. In the second diagram the sun has brought noon to 90°W. longitude For the sun to travel 90° requires 6 hours, so it is 6 hours past noon, or 18h 0m 0s GMT Midnight has moved to 90°E. longitude.

A new day starts as midnight leaves 180°. Between 180° and 90°E., it is the next day, 2 May. It is still 1 May from 90°E. westward to 180°.

Looking at the third diagram, you see that the sun has brought noon to the 180th meridian. It is midnight in Greenwich. It is now 2 May from 180° to 0° longitude in the eastern half of the earth, but still 1 May from 0° to 180° in the western half.

In the last diagram, noon has reached 90°E., and midnight has traveled 6h past Greenwich to 90°W. It is 2 May over three-quarters of the earth, from 180° around to 90°W., but it is 1 May over the quarter between 90°W. and 180°. On 2 May, GMT is 6h 0m 0s.

The date changes at the 180th meridian in all of the diagrams except the first one. Going west, it becomes the next day at 180°; going east, it becomes the day before.

When you refer to GMT in the *Nautical Almanac*, you must know what the date is at Greenwich. Frequently the date there differs from what it is in your longitude. Assume that on 1 May you are in longitude 176°41′W , and ZT is 16h 0m 0s. Divide 176° by 15 The nearest whole number is 12, the ZD. Longitude is west, therefore ZD is +12 Adding ZD to ZT, we obtain the following data

ZT	16h	0m	0s	(1 May)
ZD	+12			
GMT	28h	0m	0s	(1 May)

What have we here, 28 o'clock? Time 2800 on 1 May is the same as 0400 on 2 May Therefore, GMT is 4h 0m 0s on 2 May

Suppose that at the same ZT you were in longitude 176°41′E , on the other side of 180, where it is 2 May In this example, ZD is -12 but GMT comes out the same, the date where you are is the same as the date at Greenwich. In the former problem, it already has become a day later at Greenwich.

ZT	16h	0m	0s	(2 May)
ZD	-12			
GMT	4h	0m	0s	(2 May)

Here is a problem with a new twist Suppose you are in longitude 47°53′E , ZT is 2h 0m 0s, and the date is 2 May The ZD is -3 How can you subtract 3 from 2h 0m 0s? Time 0200 on

2 May is the same as 2600 on 1 May. The figuring goes like this.

ZT	26h	(1 May)
ZD	-3	
GMT	23h	(1 May)

ZONE AND LOCAL MEAN TIME

Zone time is a matter of convenience only It was established to keep all clocks in a specific area on the same time. The actual time where you are is the local mean time, which changes as the sun moves. Local mean time also changes as you change your longitude.

If you are located on one of the standard time meridians, then zone time and local mean time are the same. Otherwise, you must calculate local mean time according to the difference in longitude between your meridian and the closest standard time meridian. You subtract your longitude from the longitude of the time meridian. This result is in degrees, minutes, and seconds of arc, which you convert to time, and apply to the zone time.

Suppose you are in longitude 142°41′W., and ZT is 06h 21m 09s Divide 142°41′ by 15, and you find that you are in zone +10 Your standard time meridian must be 150°W. Write that down as 149°60′W, so it will be easier to subtract your longitude

Longitude time meridian . . .	149°60′W
Longitude your meridian .	142°41′W
Longitude difference	7°19′

Change 7°19′ to time, and you get 0h 29m 16s. This change means that LMT at your meridian differs from ZT by 0h 29m 16s. Whether your time is later or earlier than the time at 150°W. depends on whether you are east or west of that meridian. You are in west longitude, which is measured west from 0° to 180°, so 150°W must be farther west than 142°41′W Therefore, you must be east of the standard time meridian. It is always later to the east, consequently your LMT must be 0h 29m 16s later than ZT. This representation is as follows·

ZT	06h	21m	09s
	00h	29m	16s
LMT	06h	50m	25s

TIMEPIECES

Time measuring devices have evolved, with civilization, from the simplest sundials to complicated electronic equipment. Aboard ships, time is kept by watches, clocks, and chronometers.

CLOCKS AND WATCHES

A ship's routine activities are timed by the various ship's clocks or deck clocks, mounted on the bulkheads and usually set to ZT. When the ship enters a new time zone, all clocks are reset 1 hour one way or the other, depending upon whether the ship is moving east or west. The commanding authority may direct that the clocks be changed at some time except the instant of entry into a new zone Some other time, like daylight saving, may be selected for reasons of convenience. In some localities the ship's clocks are set to fractional zone time.

Ships are equipped with a number of clocks, depending upon the ship's size and mission. The pilothouse, engineering spaces, offices, messing spaces, and staterooms are areas that normally have clocks. Ship's clocks are of various types· 12- and 24-hour dials, direct reading, 8-day (winding period), electric, etc.

One person usually is assigned the job of winding and setting the clocks at intervals prescribed by the navigator Ship's clocks are accurate enough to time meals, watch relief, taps, liberty call, etc. The person assigned the duty of setting the clocks sets a watch to the correct time (either from a chronometer or radio time signal) and checks the accuracy of each clock by comparing it with the watch. He then notes (in a clock log) the error of each clock, winds each clock, and adjusts it to run faster or

slower, depending on whether it was gaining or losing time. No adjustment for rate is made to clocks that have only a small error.

CHRONOMETER

The most important navigational timepiece is the chronometer (fig. E-30). It is considered one of the most accurate mechanical time machines made. If a ship does not have a chronometer, and must navigate at any time by celestial observations, she is provided with a timepiece that reasonably approximates the chronometer's accuracy.

The chronometer is a clock of very fine construction. It is designed for extreme accuracy and dependability. It is built to withstand shock, vibration, and changes of temperature. It is mounted in gimbals to offset ship's motion. It must be handled with the greatest care, because its accuracy and regularity are essential in determining GMT, the basic time used in fixing position by celestial navigation.

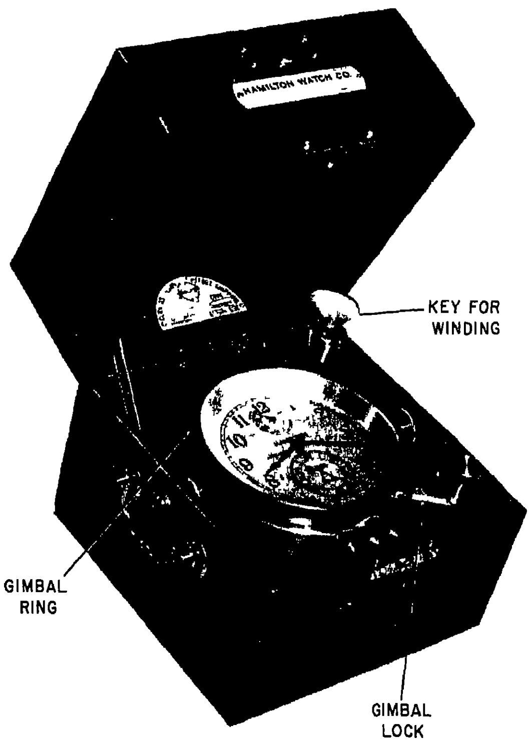

Figure E-30.—Ship's chronometer in its case.

Types of Chronometers

Two types of chronometers presently are in use: size 85 and size 35.

The size 85 chronometer (formerly called ship chronometer) is the principal navigation timepiece aboard ship. It can easily be identified by its 4-inch dial and the jerky motion of its second hand. A modified size 85 chronometer is furnished to missile carrying ships, if those ships have shipboard time/frequency standards. This modification features an electrical contact assembly (make-break circuit) capable of producing an electrical impulse every second except the 59th second of each minute. The make-break circuit keeps the DRT and other equipment on missile ships set to the correct time.

Formerly, size 35 chronometers were called chronometer watches. They are identified by their 2 1/2-inch dial and external winding stem, making them resemble large pocket watches. Although size 35 chronometers still are found on many ships, they are being phased out of the Navy.

Determining Chronometer Error

Chronometers are never reset aboard ship and accumulated error may become quite large. Such an error is unimportant if an accurate record is kept of the error.

The most accurate check on the chronometer and other timepieces is the radio time signal, broadcast by radio station NSS and other stations listed in *Radio Navigational Aids* (H O 117). Naval radio stations transmit time signals (on six different frequencies) for the 5 minutes immediately preceding certain hours GMT. These signals may be relied upon because they are accurate to within 0.01 second. You should familiarize yourself with their pattern, a description of which follows.

Each second in the time signal is marked by the beginning of a dash, the end of the dash has

no meaning. Beginning at 5 minutes before the hour, every second is transmitted except the 51st second of the 1st minute, 52nd second of the 2nd minute, 53rd second of the 3rd minute, 54th second of the 4th minute, 29th second of each minute, the last 4 seconds of each of the first 4 minutes, and the last 9 seconds of the last minute. The hour signal after the 9-second break (59m 60s) consists of a longer dash than the others. The system of dashes is shown in the table below.

Minute	Second										
	50	51	52	53	54	55	56	57	58	59	60
55	—		—	—	—	—					—
56	—	—		—	—	—					—
57	—	—	—		—	—					—
58	—	—	—	—		—					—
59	—										——

Radio stations WWV (Washington) and WWVH (Honolulu) give the correct time signal every 5 minutes, 24 hours per day. These time signals consist of a sound, which is interrupted precisely 1 minute before each hour and at 5-minute intervals thereafter The signals are broadcast on 2 5, 5, 10, 15, 20, and 25 megahertz One of these signals usually can be received in any part of the world.

The upcoming time is announced during the interruption of the sound. The exact time is taken the instant the sound is resumed An example of the voice announcement might be "This is radio station WWV When the tone returns, the time will be 8 50 a m eastern standard time, 8 50 a m."

MAGNETIC COMPASS AND GYROCOMPASS

The best known and most widely used of all navigational instruments is the compass Without it, precise information on headings and directions would be almost impossible to obtain. Compasses were used even before the days of Columbus, and they remain important in today's Navy.

The Navy uses two main types of compasses: gyroscopic and magnetic. The gyrocompass operates on the principle that a rapidly spinning object is balanced at its center of gravity, much as a spinning top stands on its point. The gyrocompass is designed to point toward true north. It may have a slight mechanical error (1° or 2°), which may be determined and for which allowance is made. The magnetic compass is controlled primarily by the magnetic properties of the earth and tends to point toward the magnetic north pole.

MAGNETISM

To fully understand the operation of the magnetic compass, it is necessary to know something about magnets themselves. A magnet is a body that has the property of attracting iron and producing a magnetic field around itself. Such materials as lodestone and magnetic oxide of iron possess this property. The earth itself may be considered a gigantic magnet

Every magnet has a north pole and a south pole If a single magnet is cut in half, each half becomes a magnet with a north pole and a south pole. If two magnets are brought close together, their unlike poles will attract and their like poles repel. A north pole attracts a south pole but repels another north pole

EARTH'S MAGNETISM

The earth, like all other magnets, has a north pole, located approximately at 76 2° north latitude, 101.0° west longitude, and a south pole, located approximately at 66 0° south latitude, 139.1° east longitude (These locations are the 1960 positions of the magnetic poles. They are different from the true north and south poles, which are at 90° north latitude and 90° south latitude, respectively.)

The magnetic lines of force that connect the magnetic poles are called magnetic meridians. Approximately midway between the magnetic poles, a line called the magnetic equator intersects the meridians and connects all points at which the magnetic dip is zero.

MAGNETIC COMPASS

The simplest magnetic compasses contain magnets whose south ends tend to seek the earth's north magnetic pole, thus making the compass point north.

Magnetic compasses used in the Navy (fig. E-31) are highly sophisticated instruments. In addition to the magnets, magnetic compasses are made up of a number of parts. Components of a standard 7 1/2-inch diameter Navy compass are given in the list below.

Magnets: Four (two in older compasses) cylindrical bundles of steel wire, with magnetic properties, which are attached to the compass card to supply directive force.

Compass card· An aluminum disk graduated in degrees from 0 to 359. (It also shows cardinal and intercardinal points.) The compass card is attached to the magnets, and provides a means of reading direction.

Compass bowl: A bowl-shaped container, made of nonmagnetic material (brass), with a reference mark on its rim. The bowl contains the magnetic element and the fluid. Part of the bottom may be transparent (glass) to permit light to shine upward against the compass card.

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Figure E-31.—U.S. Navy 7 1/2-inch standard compass.

Fluid: A liquid surrounding the magnetic element. By reduction of weight, in accordance with the Archimedes principle of buoyancy, friction is reduced. Closer alignment of the compass needle with the magnetic meridian is thus possible. The liquid in older compasses may be a mixture of ethyl alcohol and water in approximately equal parts. Alcohol serves to lower the freezing point of the mixture. Newer compasses contain varsol, an oil that neither freezes nor becomes thick at low temperatures.

Float: An aluminum air-filled chamber in the center of the compass card to further reduce weight and friction at the pivot point.

Expansion bellows: A bellows arrangement in the bottom of the compass bowl. This operates to keep the compass bowl completely filled with liquid.

Lubber's line A mark on the inside of the compass bowl, which is aligned with the ship's fore-and-aft axis. The lubber's line is a reference for reading direction from the compass card. The compass card reading on the lubber's line represents the ship's heading.

Gimbals· The compass bowl has two pivots that fit or rest in a metal ring, which also has two pivots resting in the binnacle. This arrangement (gimbals) permits the compass to remain almost horizontal despite the motion of the ship.

Binnacle A nonmagnetic housing in which the magnetic compass is mounted. It usually provides a means for inserting corrector magnets for compass adjustment

COMPASS LIMITATIONS

The following characteristics of the magnetic compass limit its direction finding ability.

1. It is sensitive to any magnetic disturbance.
2. It is useless at the magnetic poles, and is sluggish and unreliable in areas near the poles.
3. Deviation (explained later) changes as a ship's magnetic properties change. Moreover, the magnetic properties

change with changes in the ship's structure or magnetic cargo.
4. Deviation changes with heading. The ship as well as the earth may be considered as a magnet. The effect of the ship's magnetism upon the compass changes with the heading.
5. It does not point to true north.
6. It requires frequent adjustment.

PRECAUTIONS IN VICINITY OF MAGNETIC COMPASS

A magnetic compass will not give reliable service unless it is properly installed and protected from disturbing magnetic influences. Certain precautions must be taken in the area of the magnetic compass. Some of these precautions follow.

A compass should not be placed near iron or steel equipment that will be moved often. A location near a gun, boat davit or boat crane is not good. The immediate area should be kept free of sources of deviation, particularly those of changing nature. No source of magnetism (except the structure of the vessel) should be allowed within a distance of several feet of the magnetic compass Some sources that might be overlooked include electric wires carrying direct current, magnetic instruments, searchlights, windshield wipers, electronic equipment, or motors, steel control rods, gears, or supports associated with the steering apparatus, fire extinguishers, gas detectors, etc.; and metal hangers, flashlights, keys or pocketknives

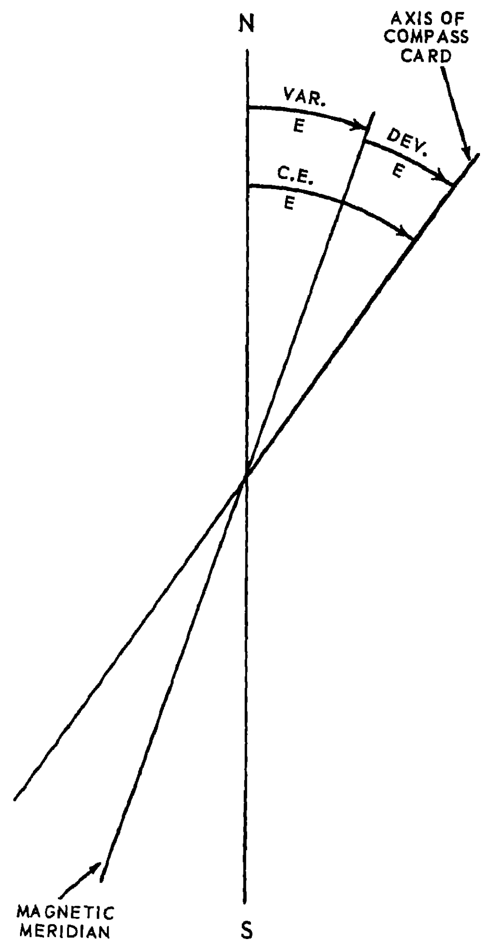

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Figure E-32.—Components of compass error.

MAGNETIC COMPASS ERROR

Compass error may be computed easily. It is simply the sum of variation and deviation. Compass error (fig. E-32) must be applied to a compass direction to obtain true direction. It must be applied to true direction, with signs reversed, to arrive at compass direction.

VARIATION

Because the magnetic north pole and the true north pole are not located at the same point, the magnetic compass does not seek true north. The magnetic compass aligns itself with the direction of the earth's magnetic field at the compass location. It does not always point toward the north geographic pole. The amount the needle is offset is called variation, because it varies at different points on the earth's surface. Even at the same place it usually does not remain constant, but increases or decreases at a certain known rate.

The variation for any given locality is shown on the compass rose of the chart for that particular locality, together with the amount of annual change.

Variation remains the same for any heading of the ship at a given locality. No matter which

direction the ship is heading, the magnetic compass, if affected by variation only, points steadily in the general direction of the magnetic north pole.

DEVIATION

The amount a magnetic compass needle is deflected by magnetic material in the ship around it is called deviation.

The best method of determining deviation is to check your compass on each 15° heading against a properly working gyrocompass. Because your ship must be on a magnetic heading when determining deviation, gyro error and local variation must be applied to each true heading.

Some other methods of finding deviation follow.

1. By comparison with a magnetic compass of known deviation· This method is similar to comparison with a gyrocompass except that it is unnecessary to know the local variation. This method is used frequently by ships not equipped with gyrocompasses

2. By reciprocal bearings: One observer is stationed ashore with a spare compass, which is placed where it is free from local magnetic influences. An observer aboard the ship stands by the compass to be checked. When the ship is steady on the desired heading, a prearranged signal is made. Each observer notes the bearing of the other. The reverse bearing of the compass ashore, which has no deviation, is the magnetic bearing of the ship. The difference between this bearing and the bearing indicated by the compass on board is the amount of deviation on that particular heading. This method is not very convenient and probably will never be used until all other methods of determining deviation are exhausted.

3. By ranges: This method uses a range whose magnetic bearing is known. The ship steams on the various headings, and notes the bearing of the range on her compasses for each heading as she crosses the range. The deviation for each compass is the difference between the known magnetic bearing of the range and the bearing indicated on the compass.

4. By azimuths of the sun or other celestial body: In this method the magnetic azimuth of the body is determined by applying local variation to the body's true azimuth.

5. By distant objects· In this method, the ship must be a great distance from a large object. If the ship is being swung at anchor, the object should be at least 6 miles away. If she is steaming on different headings the object must be at least 10 miles away. The ship is steadied on given headings, and the compass bearing of the object is taken on each heading. Magnetic bearings may be found from a chart. Deviation on each heading is the difference between compass and magnetic bearing of the object. This method is used only when none of the others can be used

CORRECTING COMPASS ERROR

The sum of the variation and deviation is the magnetic compass error The course you want the ship to head is the true course, worked out from the chart on which true courses and bearings are given. Knowing the true course, it is necessary for you to find the compass course you must steer and to make good the true course. Compass course is found by applying the compass error to the true course

Your problem could be the other way around. Suppose you have a bearing taken by magnetic compass. Plotting true bearings on the chart is better than plotting magnetic bearings. Therefore, you must apply variation and deviation to the compass bearing to obtain the true bearing.

Changing from true course to compass course, or vice versa, may be accomplished more easily by means of this handy key, in the form of the question: CAN DEAD MEN VOTE TWICE? It's a sure bet that dead men cannot vote once, let alone twice; hence this question has no actual meaning. It is merely handy in solving our problem of correcting compass error.

First, write each word of the question in column form, then opposite each word set down what it represents, as follows:

Can	Compass
Dead	Deviation
Men	Magnetic
Vote	Variation
Twice	True

Your problem will always be either (knowing the true course) to work up the line to the compass course, or (knowing the compass course) to work down the line to the true course. Going up the line, or changing from true to compass, is called uncorrecting. Coming down the line, or changing from compass to true, is called correcting. All you actually have to remember is this rule. When correcting, ADD easterly and SUBTRACT westerly error. When uncorrecting, SUBTRACT easterly and ADD westerly error. It is as simple as that. All compass errors, whether due to variation or deviation, are either easterly or westerly. There are no northerly or southerly errors.

Now, work a problem. Suppose the true course you want to head is 000° and you want to know the course to steer by magnetic compass. In other words, you are uncorrecting. This time, write the initial letters of each word of the old question in a line

←—W + E—→
C D M V T

You already know what T is, so write it down

←		W + E		→
C	D	M	V	T
				000°

Assume the chart shows a variation of 11°E. Now you have

←		W + E		→
C	D	M	V	T
			11°E	000°

When uncorrecting, remember that you subtract easterly and add westerly errors. This 11° is an easterly variation, so you subtract it from 360°, and get a magnetic course of 349°. Write that down.

←		W + E		→
C	D	M	V	T
		349°	11°E.	000°

Sometimes you need to know a magnetic heading or bearing. If that is all you are looking for in this example, you could stop right here. This time, however, you want to go on and find the compass course. Assume the deviation table shows a deviation of 14°W. for a 349° heading. Write that down.

←		W + E		→
C	D	M	V	T
	14°W.	349°	11°E.	000°

When uncorrecting, you add westerly error, so add 14° to 349° and get 003° Now you have.

←		W + E		→
C	D	M	V	T
003°	14°W	349°	11°E.	000°

In order to head 000° true, therefore, you must steer 003° by this particular magnetic compass

Note in our sample problem that the easterly variation and westerly deviation almost canceled each other, leaving an error of only 3°W If you do not want to go through the correction process in detail, you can find the algebraic sum of the errors beforehand This advance preparation is done by subtracting the lesser from the greater if they are unlike, or adding them if they are like Then you can apply the result directly, to either T or C, depending on whether you are correcting or uncorrecting

We were uncorrecting this time, changing from true to compass. We could have used the same method to change from compass to true, but we must remember that when correcting, we add easterly and subtract westerly errors

ADJUSTING VERSUS COMPENSATING

As you know by now, magnetic material around the compass is a cause of deviation.

Another cause of compass deviation is electrical circuits. In particular, the ship's degaussing currents have a strong effect on the magnetic compass. (Degaussing, discussed later, is an electrical installation designed to protect ships against magnetic mines and torpedoes.) The deviation resulting from these currents is neutralized by a procedure called compensation. You should know the difference between adjusting the compass, which means correcting for deviations caused by magnetic material, and compensating the compass, which means correcting for deviations produced by degaussing currents.

STANDARD AND STEERING COMPASS

The magnetic steering compass is located in the pilothouse where it is affected considerably by deviation. Usually the standard compass is topside, where the magnetic forces producing deviation are not so strong. Courses and bearings by these compasses must be carefully labeled by the abbreviations psc (per standard compass), pstgc (per steering compass), and pgc (per gyrocompass). The standard compass provides a means for checking the steering compass and the gyrocompass.

The steering compass on many ships has been replaced by a repeater, which transmits indications from a magnesyn compass. (The word magnesyn is formed from the term magnetic synchronized.) It is located on a mast or at some other point where deviation is small.

Some ships may have a third magnetic compass located at the after steering station where that station is topside. This compass is known as the emergency steering compass.

DEGAUSSING

In discussing the magnetic compass, we mentioned that it is affected by degaussing. The subject is explained in the ensuing topics

SHIP'S MAGNETIC FIELD

A ship is a magnet because of magnetic material (steel) in its hull, machinery, and cargo. Like any other magnet, it is surrounded by a magnetic field that is large near the ship and small at a great distance from it. When a ship is close to a magnetic mine or magnetic torpedo, the magnetic field of the ship causes the mine or torpedo to explode.

Degaussing equipment is installed aboard ship to cancel the ship's disturbance of the earth's magnetic field. This gives protection against the magnetic mine or magnetic torpedo.

Two methods are used to decrease a ship's magnetic field. They are the magnetic treatment (called deperming) and the shipboard degaussing installation.

Magnetic Treatment

Magnetic treatment is given by deperming stations to provide antimine protection. This treatment reduces the magnetic field of the ship so there is less chance of making a magnetic mine or magnetic torpedo explode. Magnetic treatment gives some protection, but is not as good as the protection given by shipboard degaussing installations. Magnetic treatment is seldom used alone.

Shipboard Degaussing Installation

A shipboard degaussing installation consists of permanently installed equipment. The major items are degaussing coils, a power source for the coils, a control unit to control the coil current, and compass compensating equipment to prevent the magnetic field of the degaussing coils from affecting the magnetic compasses

DEGAUSSING SETTINGS

Energizing the degaussing equipment consists of setting the coil currents to the value specified for the part of the world in which the ship is operating. The degaussing coil currents are set to the required values and are checked by an Electrician's Mate at least once every hour. They are readjusted to the correct value when

necessary. This continual check is necessary because the changes in degaussing coil resistance, created by variations in both the cable temperatures and in the voltage of the power supply for the degaussing coils, alter the degaussing coil currents. The coil currents must have the correct polarity. If the polarity setting of any coil is incorrect, the ship is in much greater danger from magnetic mines than if the ship has no degaussing system installed. This is because the total magnetic field of the ship is stronger than before. On the bridge, the Quartermaster checks the polarity of the coils hourly by observing the neon indicator light on the control panel.

Most new vessels are equipped with automatic degaussing control equipment to change coil currents automatically. Under certain conditions, a manual coil current adjustment still is necessary. Indicator lights, standard on all automatic control equipment, show when the equipment is functioning incorrectly.

DEGAUSSING RANGES

A degaussing range is a station for measuring and recording the magnetic fields of ships as they pass over measuring equipment located on the bottom of the channel in which the ship travels. The measurements recorded are used to compute the coil currents required for degaussing

The procedure for making a run on a degaussing range starts with a request to the degaussing station After receiving permission from the degaussing station, an immediate check is made of the degaussing chart to get the correct setting for each coil installed. These settings are made and checked before the run is started. The commanding officer adjusts the ship's speed according to instructions from the degaussing station. It is customary to run the range on one heading, followed by a run on the opposite heading.

Results of the runs are entered in the ship's degaussing folder by personnel of the degaussing station. Through periodic checks of the equipment in this manner, any shortcomings can be detected easily and corrected immediately so that protection will be available when it is needed.

COMPASS COMPENSATING EQUIPMENT

It is important to protect the ship's magnetic compasses from the magnetic influence of the degaussing system. An unattended degaussing system would be of sufficient magnitude to make the compasses useless for navigation.

The purpose of compass compensating coils is to set up a magnetic field that is equal to and opposite the degaussing coil field near the compasses.

Most standard types of compass compensating coils are composed of an enclosure, a single heeling coil to compensate the vertical component, and two coils, or two pairs of coils, to compensate the cardinal or intercardinal components. Each coil consists of a number of windings. There is one winding for each degaussing coil, which produces a magnetic field that must be compensated. Compass compensating coils usually are installed and adjusted at a naval shipyard or a degaussing activity.

MAGNETIC COMPASS TABLE

In figure E-33 you see the prepared form in general use for recording deviations (Form NavShips 3120/4). On the form the deviations for every 15° around the compass are shown Note that deviations are recorded in two columns headed DG OFF and DG ON The deviations in the first column were recorded with the ship's degaussing system secured. For the second column, readings were taken with the ship's degaussing system energized Whether the degaussing system is on or off may cause a considerable difference in the deviation, hence each condition must have a separate column. In correcting or uncorrecting, it is important that you use the deviation for the proper condition of the ship's degaussing system.

MAGNETIC COMPASS TABLE NAVSHIPS RPT 3530 2
NAVSHIPS 3120/4 (REV 6-67) (FRONT) (Formerly NAVSHIPS 1104)
S/N 0106-601-9620

U S S Anyship NO — (BB CL DD etc)

[X] PILOT HOUSE [ ] SECONDARY CONNING STATION [ ] OTHER

BINNACLE TYPE [X] NAVY ST'D [ ] OTHER

COMPASS 7½ MAKE Lionel SERIAL NO 1592

TYPE CC COILS "K" DATE 22 September 1970

READ INSTRUCTIONS ON BACK BEFORE STARTING ADJUSTMENT

SHIPS HEAD MAGNETIC	DEVIATIONS DG OFF	DEVIATIONS DG ON	SHIPS HEAD MAGNETIC	DEVIATIONS DG OFF	DEVIATIONS DG ON
0	0.5E	0.5E	180	0.5W	0.0
15	1.0E	1.0E	195	1.0W	0.5W
30	1.5E	1.5E	210	1.0W	1.0W
45	2.0E	1.5E	225	1.5W	1.5W
60	2.0E	2.0E	240	2.0W	2.0W
75	2.5E	2.5E	255	2.0W	2.5W
90	2.5E	3.0E	270	1.5W	2.0W
105	2.0E	2.5E	285	1.0W	1.5W
120	1.5E	2.0E	300	1.0W	1.0W
135	1.5E	1.5E	315	0.5W	0.5W
150	1.0E	1.0E	330	0.5W	0.5W
165	0.0	0.5E	345	0.0	0.0

DEVIATIONS DETERMINED BY [ ] SUN'S AZIMUTH [X] GYRO [ ] SHORE BEARINGS

B 6 MAGNETS RED [ ] FORE [X] AFT AT 14" FROM COMPASS CARD

C 14 MAGNETS RED [ ] PORT [X] STBD AT 8" FROM COMPASS CARD

D 2-7 [X] SPHERES [ ] CYLS AT 12" [X] ATHWARTSHIP [ ] SLEWED —° [ ] CLOCKWISE [ ] CTR CLOCKWISE

HEELING MAGNET [ ] RED UP [X] BLUE UP 10" FROM COMPASS CARD FLINDERS BAR [X] FORE [ ] AFT 14"

[X] LAT 38° 15'N [X] LONG 70° 20'W
[ ] H .190 [ ] Z .525

SIGNED (Adjuster or Navigator) T.G. PARRISH APPROVED (Commanding) J. FERRIS

69.13

Figure E-33.—Magnetic compass table.

To compute the deviation on any magnetic heading not given in the table, it is necessary to make a comparison between the two nearest recorded readings. If the deviations recorded on each 15° heading do not vary by more than 1/2° from the adjacent readings, you may use the deviation for the heading nearest the one you are checking.

GYROCOMPASS

The gyrocompass is not affected by either variation or deviation. When in proper running order, it points constantly to the true rather than the magnetic north pole. It may have a slight mechanical error, but this error is computed easily. It remains constant for any heading, so that it does not interfere in any way with the instrument's practical value.

The gyrocompass works so well that you may wonder why the magnetic compass is used at all. The reason is simple: The magnetic compass operates through the attraction exerted by that great natural magnet, the earth. The earth is absolutely certain to continue to function as a magnet, therefore the magnetic compass will never go out of commission because of any failure of its source of power.

The gyrocompass is powered by electricity Cut off the supply, and the gyro is absolutely useless. It is an extremely complicated and delicate instrument. It also is subject to mechanical failure. Some gyros become erratic after a ship makes a series of sharp turns at high speed. These disadvantages do not mean that great confidence cannot be placed in the gyro It can be depended upon, when running properly, to point faithfully and steadily to true north But it is the magnetic compass that always remains the standby, constantly checking the gyro's performance, and ready at all times to take over if the gyro fails

MASTER GYROS AND GYRO REPEATERS

A typical shipboard installation consists of one or more master gyros, whose indications are transmitted electrically to repeaters. The gyro repeaters are located in the conning stations, on

the bridge wings, and at other points as may be necessary.

A chief advantage of the gyro is that its repeaters may be set up at any angle–nearly on edge for the convenience of steersmen, or flat for taking bearings.

The master gyro must be started at least 4 hours before getting underway to allow time for it to settle before use.

PART F

SEAMANSHIP

Seamanship is one of the oldest and most traditional subjects in naval studies. In this part, you will study two subdivisions of seamanship: marlinspike seamanship and deck seamanship.

Marlinspike seamanship began in the earliest days of the simple sailing vessel. You will study ropes and lines and knots. How ropes and lines are handled and how to tie certain knots are the very basic parts of marlinspike seamanship.

As ships got larger and more persons were required to man them, the need for deck seamanship became more important. You will study what the Deck Department of a ship does. You will study the equipment and procedures of the Deck Department. Also in this section, you will study watchstanding. You will learn why watches are important and how to stand them correctly. You will also learn about shipboard safety and the importance of a good "seaman's eye". The information on this part will be found within this text.

MARLINSPIKE SEAMANSHIP

Marlinspike seamanship is the art (and it is an art) of handling and working all kinds of fiber and wire rope. It includes every variety of knotting, splicing, worming, parceling, serving, and fancywork. Although canvas and leather work is not included under marlinspike seamanship, these subjects are discussed in this chapter.

You do not want to start right off trying to tie a 21-strand Turk's head before you are able to tie the simpler knots. This chapter gives you all the marlinspike seamanship you need to know. You will not find it hard to learn, but get it down pat before you start on any fancy work.

A real seaman has a loving affection for a sound piece of line or a good square knot or splice. A look at the way a person handles the line tells an oldtimer whether one is a seaman. Knowledge of marlinspike seamanship is the real test for a deck sailor.

It is not news to an experienced seaman that misuse and abuse of his gear shortens its useful life. This is particularly true of rope of all types, yet rope is the one thing that probably receives more abuse than any other equipment the seaman uses. Also, rope in a doubtful condition puts lives in danger. The miracle is that more injuries do not occur. The first few pages of this chapter tell the fundamentals you need to know about the use and care of rope of all kinds.

Rope is a general term, and can be applied to both fiber and wire rope. But in the Navy, sailors refer to fiber rope as line, whereas wire rope is referred to as rope, wire rope, or just wire. More exactly, a line is a piece of rope, either fiber or wire, which is in use or has been cut for a specific purpose, such as lifeline, heaving line, lead line, and so on.

Information in the first part of this chapter needs no further explanation. The parts on knots and splicing, however, may be a bit more difficult to understand.

ROPE CONSTRUCTION

FIBER ROPE

Any rope that is not wire is fiber rope. Except in a few instances where it is put to certain special uses, fiber rope is never called anything but line aboard ship. For example, there are fiber manropes on gangways, foot ropes on hammocks (and formerly on the yards of sailing ships), bolt ropes on sails and other canvas, ridge ropes on awnings (but they usually are of wire), dip ropes for passing some object under, outside of, or around another, and bull ropes for heavy heaving without benefit of a purchase (tackle).

Some small craft have fiber wheelropes running from wheel to rudder, although these are more likely to be of wire. There are other exceptions as well, but all the exceptions merely go to prove the strict general rule that aboard ship a line is never called a rope.

In the manufacture of line, the fibers of various plants are twisted together in one direction to form yarns. The yarns are twisted together in the opposite direction to form strands. Then the strands are twisted together in the opposite direction to form the line. In the days when ships had fiber anchor cables, three or four lines were twisted together to form the cable. The chain, wire, or line that connects a ship to her anchor is called her anchor cable, regardless of its makeup.

By far, the greater part of line now in use is right-laid, so that the strands in the finish line spiral along in a right-handed direction as one looks along the line. Right-laid line must always be coiled down right-handed, or clockwise. Coiling down a right-laid line left-handed is a glaring blunder in seamanship, resulting in much scornful comment among bystanders. If any left-laid line does turn up, however, it should be coiled down left-handed.

Nearly all line used nowadays is three-strand, although four-strand is sometimes used.

WIRE ROPE

The basic unit of wire rope construction is the individual wire. It is made of steel or other metal in various sizes. The wires are laid together to form strands. The number of wires in a strand varies according to the purpose for which the rope is to be used. A number of strands are laid together to form the wire rope itself. Wire rope is designated by the number of strands per rope and the number of wires per strand. A 6 x 19 rope has 6 strands with 19 wires per strand. Its outside diameter is the same as a 6 x 37 wire rope, which has 6 strands with 37 wires of much smaller size per strand. Wire rope made up of a large number of small wires is flexible, but the small wires break easily so the wire rope is nonresistant to external abrasion. Wire rope made up of a smaller number of larger wires is more resistant to external abrasion but is less flexible.

The strands of the wire rope are laid up around a central core, which may be only a single wire, a single strand of wire, or hemp. A hemp core has flexibility, cushions the strands as the wire rope contracts under strain, and holds a portion of lubricant for continuous lubrication. A wire core is stronger than hemp and can be used where conditions such as high temperatures would damage hemp. An end view of the arrangement of strands in wire rope is shown in figure F-1.

Wire rope may be fabricated by either of two methods. If the strands or wires are shaped to conform to the curvature of the finished rope before they are laid up, the wire rope is called "preformed." If they are not shaped before fabrication, the wire rope is termed "nonpreformed." When cut, preformed wire

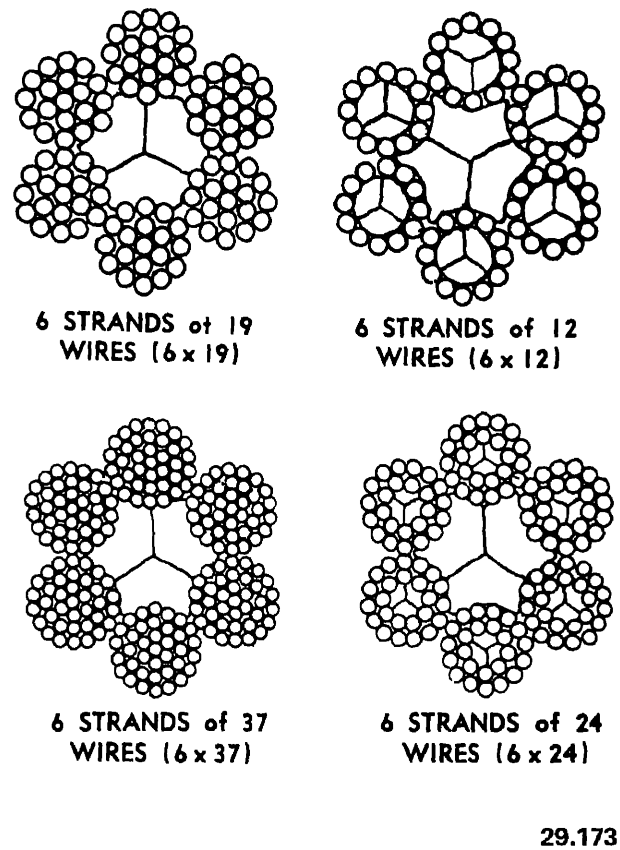

Figure F-1.—Arrangement of strands in wire rope.

rope tends not to untwist and is more flexible than the other

Wire rope is made in the following grades improved plow steel, plow steel, mildplow steel, cast steel, and other grades for such special purposes as iron, bronze, and stainless steel. The basic metal may be plain or galvanized, but galvanizing makes the wire rope stiffer and reduces the strength by as much as 10 percent.

NYLON LINE

During recent years, the Naval Ship Systems Command (NavShips) has evaluated different types of synthetic line, such as nylon, dacron, and polyethylene. This chapter discusses only nylon.

Normally, the construction of plain or rope-laid nylon is right-handed. The line should be coiled on capstans and reels in a clockwise direction. Cable-laid nylon line is left-laid. It

should be coiled on capstans or reels in a counterclockwise direction. Double-braided nylon line is made up of a core and a cover, both woven (like signal halyards) and equal in strength.

FIBER ROPE

TYPES

Most large line seen aboard ship is manila line, made from the fibers of the abaca, or wild banana plant, raised chiefly in the Philippine Islands. It has been discovered that line constructed of abaca fibers is far superior to any other natural fiber in strength, durability, ease in handling, and resistance to weather.

Until the development of nylon, manila was the best of the rope-making fibers in strength. It also was the most expensive. It was natural to compare other ropes with manila, and it still is convenient to do so. The accompanying table gives the comparative strengths of the various rope-making fibers in percentage of the strength of manila (all synthetics are stronger than manila).

Rope types	*Strength rating* (percent)
Manila	100
Nylon	275
Composite	90
Sisal	80
Sisal mixed	75
Sisal hemp	70
Jute	60
Agave	60

Line shaped from the fibers of the hemp plant was used extensively before the general adoption of manila. Line of pure hemp seldom is seen today, but hemp is often mixed with manila or sisal to form mixed or composite lines.

Small white line for lead lines, signal halyards, and the like, is of either cotton or flax. In general, it is plaited or braided instead of being laid up rope-fashion in twisted strands. Lines fashioned from flax show a decidedly yellow color.

The proper steps employed in handling fiber rope are described in the next three topics.

Measuring

When you have a new coil of line to open, remember that if you open it backwards, or from the wrong end, you will have a kink for every turn in the coil. Every kink must be unwound by walking it out the entire length of the line. When you start to walk out a kink from the middle, you run into the next kink, and the next, and so on, until the line is one large tangle.

The end of a new coil to be drawn out first is marked with a tag. But don't rely solely on the tag. Occasionally, it is on the wrong end The only way you can be sure that you are opening a coil properly is to know how to do it! The inside of every new coil is in the form of a round tunnel. At one end of the tunnel is the inside end of the line. This inside end always comes out first, usually from the bottom of the tunnel up through. Reach through the tunnel until you find the end, and determine on which end to set the coil so that the line will uncoil in a counterclockwise direction. Reach in, draw the end up through the tunnel, and the entire coil will run off without a kink. The important point to bear in mind is that when you pull on the inside end, the line must uncoil in a counterclockwise direction.

Making Up Line

Once line is removed from the manufacturer's coil, it may be made up (disposed of for storage or for ready use) either by winding on a reel or by coiling down, faking down, or flemishing.

Coiling down a line means laying it up in circles, roughly one on top of the other Always coil down right-laid line right-handed, or clockwise. Figure F-2 shows you how to coil down a right-laid line. When a line is coiled down, one end is ready to run off. (This end went down last and now is on top.) If you try to walk away with the bottom end, a foulup results. If the bottom end must go out first, you must upset your entire coil to free it for running.

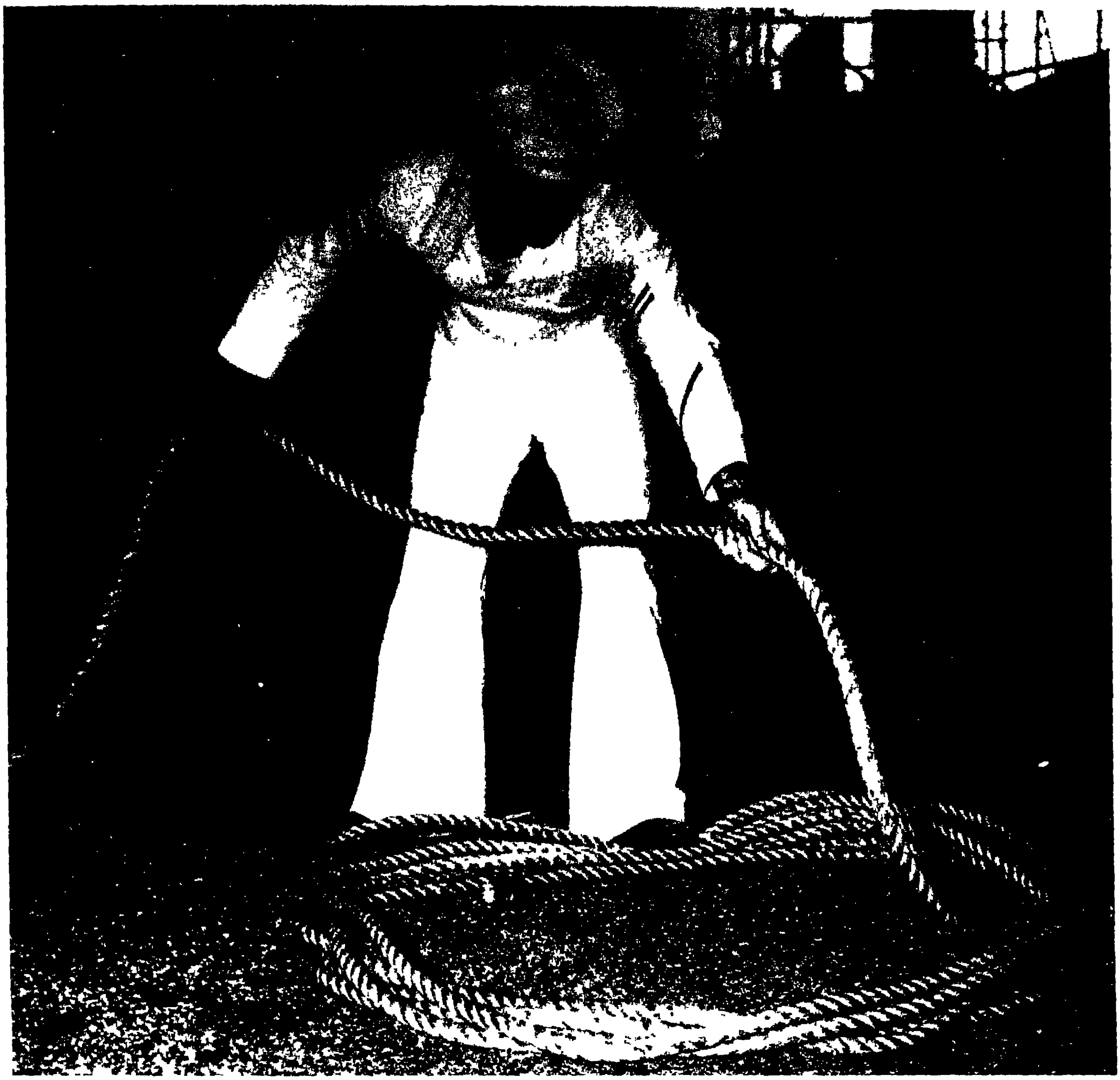

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Figure F-2.—Coiling down a line.

Faking down a line (fig. F-3) is laying it up in the same manner as for coiling down, except that it is laid out in long, flat bights, one alongside the other, instead of in round coils. The main advantage of working with line that is faked down is that it runs off more easily.

To flemish down a line, start with the bitter end and lay on deck successive circles of line in the manner of a clock spring with the bitter end in the center (fig. F-4). Right-laid line is laid down clockwise, left-laid line, counterclockwise They are laid down loosely and wound tight to

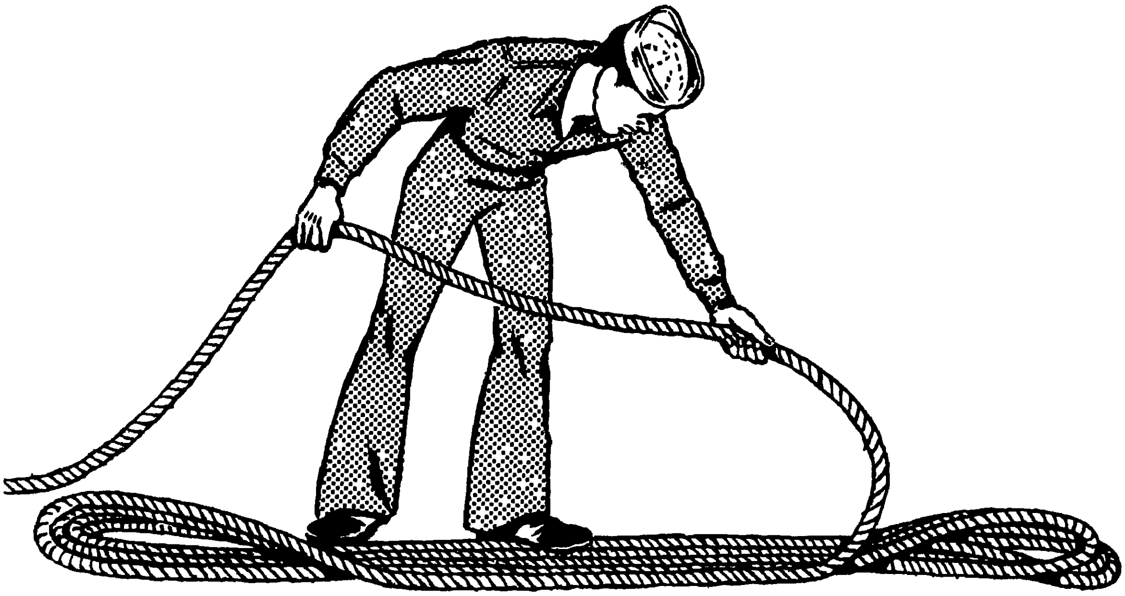

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Figure F-3.—Faking down a line.

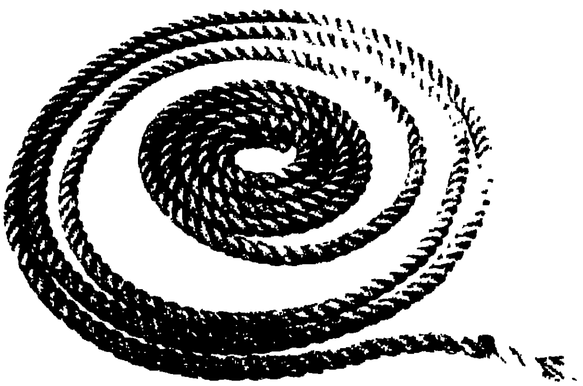

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Figure F-4.—Partially flemished line.

form a mat by placing the hands flat on the line and twisting in the direction the line is laid. Short lengths of lines, such as bitter ends of boat painters, boat boom guys, and topping lifts, usually are flemished down.

Securing Ends

Never leave the end of a line dangling loose without a whipping to prevent it from unlaying. It will begin to unlay of its own accord. To see a good piece of line frazzled out this way is painful to a real seaman. To prevent fraying, a temporary plain whipping can be put on with anything, even a rope yarn, as shown in figure F-5. Lay the end of the whipping along the line and bind it down with a couple of turns. Then lay the other end on the opposite way, bind it with a couple of turns from the bight of the whipping, and pull your end tight

A permanent whipping is put on with a palm and needle. Thread a needle with sail twine, doubled (fig. F-6 shows single twine for clearness), and shove it through the middle of a strand so that is comes out between two strands on the other side. Bind the end down with six or eight turns wound on from inboard toward the end, and again shove the needle through the middle of a strand near the end so that it comes out between two strands again. Then go up and

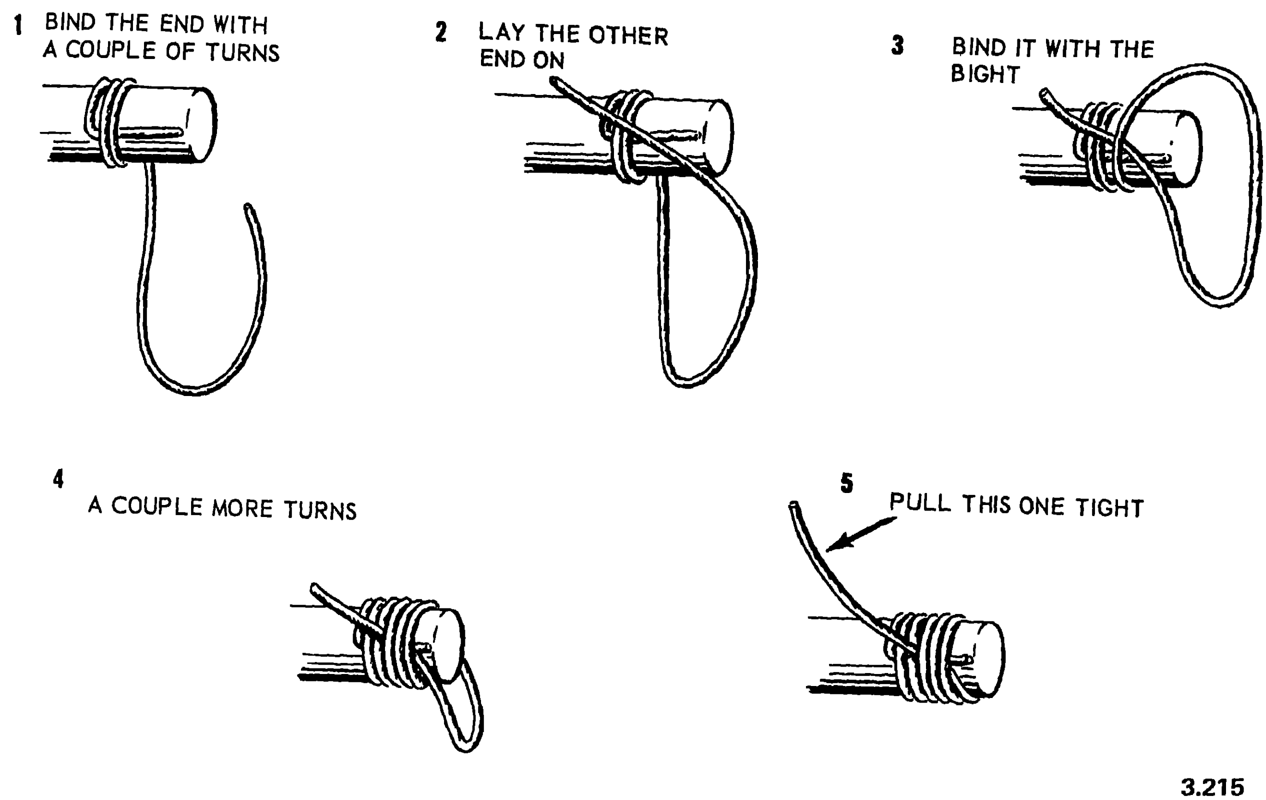

Figure F-5 —Plain whipping a line.

down between strands so as to place a cross-seizing between each pair, as in figure F-6.

Pull each cross-seizing taut before taking the next one, and have the needle come out through the middle of a strand on the last shove through, so the strand will hold the end after you cut the sail twine Remember The turns of whipping must be wound on FROM the line TOWARD the end, otherwise the needle will come out at the wrong side of the whipping after you make the final cross-seizing When cutting a line, it is best to put on the whipping before cutting. Ends of small stuff can be laid up with a palm and needle whipping.

WIRE ROPE

TYPES

Although wire rope is made from many different metals, most of what the Navy uses is made from steel The Navy specifies a minimum tensile strength in wire of 220,000 pounds per square inch. Extra strong crucible steel, plow steel, and monitor steel wire all meet Navy specifications. Plow steel wire is the type used most commonly

As distinct from line, wire size is always designated by its diameter in inches, rather than by its circumference As the circumference of a circle is roughly three times its diameter, a 1-inch wire is about the same size as a 3-inch line

Rust is the chief enemy of wire rope Some wire ropes are galvanized or treated chemically to prevent them from rusting. Galvanizing detracts somewhat from the strength of wire and makes it much stiffer and harder to handle For this reason, the wire used in running rigging is not galvanized.

Flexible wire rope, called spring lay, is often used for wires that require a good deal of handling–for example, mooring wires. Flexible

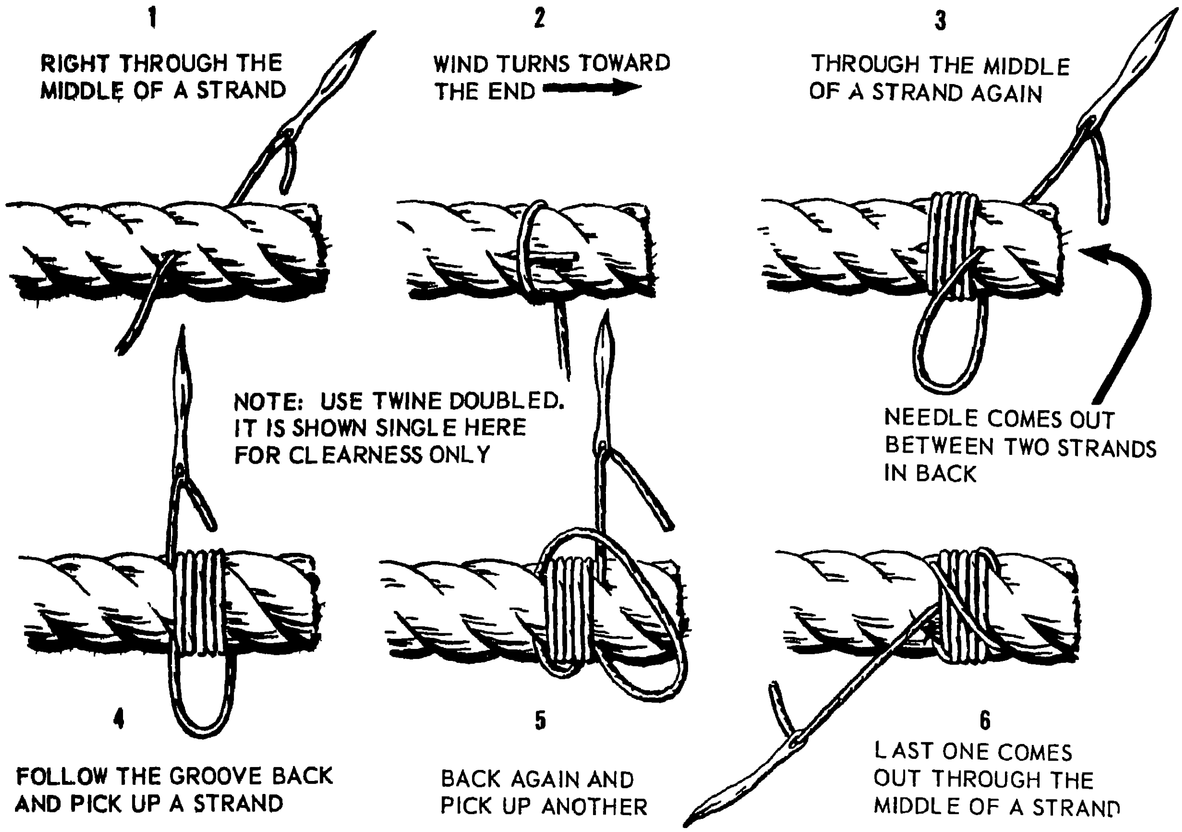

Figure F-6.—Palm and needle whipping

wire rope is composed partly of wire and partly of fiber. It has substantially less strength than all-steel wire of corresponding size. Spring lay is always galvanized.

CARE OF WIRE ROPE

Right-laid wire, like right-laid line, should be taken right handed around catheads and capstans to avoid kinking. A hard strain on a wire with a kink in it is even worse than a strain on a kinked line. Kinks in wire must be avoided.

Wire that has been used wears like any other metal article. The outer parts of the strands begin to flatten out. As a result, the diameter of the wire decreases. Individual strands of wire begin to wear through, and fishhooks appear here and there. A wire with an overstrain also shows a great many fishhooks, and a marked decrease in diameter where the strain occurred.

Wire rope should be inspected often, checking for fishhooks, kinks, and worn out corroded spots. Worn spots show up as shiny flattened surfaces. To determine the wear, you must know (1) the original diameter of the wire rope, (2) the present diameter of the wire rope at the worn area, and (3) the diameter of a single wire in one of the strands of the wire rope. The actual diameter is found by measuring with a micrometer or vernier caliper, as shown in figure F-7 Now, subtract the measured diameter of the wire rope from the original diameter. If the difference is half the diameter of the single wire, the safe working load of the wire rope is reduced. If the difference is equal to, or greater than the diameter of the single wire, replace the rope. Even if no worn spots are apparent, wire

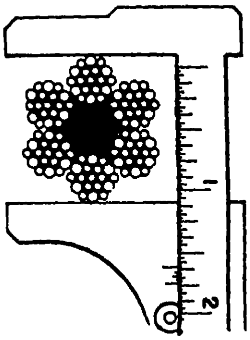

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Figure F-7.—Measuring wire rope.

rope should be measured to determine the overall wear. Take three or four measurements at intervals of several feet and find the average. The same rule applies here as with worn spots. Replace the rope if the outer wires are worn to one-half their original diameter.

Rusting and corrosion of the wires and deterioration of the fiber core decrease the strength of a rope. It is impossible to estimate accurately the loss in strength from these effects.

Wire rope should not be stored in places where acid is or has been kept. The importance of keeping acid or acid fumes away from wire rope must be remembered. The slightest trace of acid coming in contact with wire rope will damage it at that particular spot. Many times, wire rope that has given away at one point has been found to be damaged by acid.

Prior to storage, wire rope should always be cleaned and lubricated. If the lubricant film is applied properly and the wire is stored in a dry place, it will not corrode.

The importance of lubricating wire rope arises because wire is really a mechanical device with many moving parts. Each time a rope bends or straightens, the wires in the strands and the strands in the rope must slide upon each other. A film of lubricant is needed on each moving part. Another important reason for lubrication is to prevent corrosion of the wires and deterioration of the hemp core.

Used wire ropes should be cleaned before they are lubricated. They may be cleaned with wire brushes, compressed air, or by superheated steam. The object is to remove all foreign material and old lubricant from the valleys between the strands and from the spaces between the outer wires.

Lubricant may be applied with a brush and worked in well. Another method is to pass the wire rope through a box containing the lubricant.

Two good lubricants for wire ropes are raw linseed oil and a medium graphite grease. Raw linseed oil dries and is not greasy to handle. However, graphite grease is preferable in most instances because it is highly resistant to salt water corrosion.

Commercial lubricants may be used; the best is a semiplastic compound, applied hot in a thinned condition. It penetrates while hot, then cools to a plastic filler, preventing the entrance of water.

If a heavy strain was put on a wire rope with a kink in it, the rope can no longer be trusted. Cut out the kinked part and splice the ends together. Abrasion or sharp bends often cause individual wires to break and bend back. These breaks are known as fishhooks. If several occur at a point near each other, or several wires are broken along the wire rope's length, the safe working load is reduced greatly. When 4 percent of the total number of wires in the wire rope are found to have breaks within the length of one wire rope lay, the rope is unsafe for use. Consider the rope unsafe if three broken wires are found in one strand of 6x7 rope, six broken wires are found in one strand of 6x19 rope, or nine broken wires are found in one strand of 6x37 rope.

Some common causes of wire rope failure include the following:

1. Incorrect size, construction, or grade.
2. Allowed to drag over obstacles.
3. Improperly lubricated.
4. Operated over sheaves and drums of inadequate size.
5. Overriding or crosswinding on drums.
6. Operating over sheaves and drums out of alignment.

7. Operating over sheaves and drums with improperly fitted grooves or broken flanges.
8. Permitted to jump sheaves.
9. Subjected to moisture or acid fumes.
10. Improperly attached fittings.
11. Permitted to untwist.
12. Subjected to excessive heat.
13. Destroyed by internal wear caused by grit penetrating between the strands and wires.
14. Subjected to severe overload because of inefficient operation.
15. Kinked condition.

HANDLING WIRE ROPE

Long lengths of wire rope usually are mounted on reels when they are received. Never attempt to unreel wire rope from a stationary reel. Mount the reel on a pipe or rod supported by two uprights. This method allows the reel to turn as the wire rope is pulled. Unreeling presents no problem, but spooling the wire rope back onto the reel may give you some trouble unless you remember that it tends to roll in the opposite direction from the lay. For example, a right-lay wire rope tends to roll to the left. It should be started at the left and worked toward the right when spooling over the top of the reel. When spooling under the reel, start at the right and work toward the left. Left-lay wire rope is handled just the opposite.

If wire rope is being run off one reel to a winch drum or another reel, it should be run from top to top or from bottom to bottom, as in figure F-8.

Short lengths of wire rope may be made up in coils and stopped off tightly for stowage When uncoiling wire rope, stand the coil on edge and roll it along the deck, uncoiling as you go, as in figure F-9.

If a wire rope becomes kinked, never try to pull the kink out by putting a strain on either part. As soon as a kink is noticed, uncross the ends by pushing them apart. (See step 1 in figure F-10.) This method reverses the process that started the kink. Now, turn the bent portion over and place it on you knee or some firm object and push downward until the kink straightens out somewhat. Then lay it on a flat surface and pound it smooth with a wooden mallet.

Once a new coil of wire is unwound properly, it can be coiled down for running. Because of the general toughness and springiness of the wire, a bight frequently may back up against you and try to flop the other way. When it does, don't "fight" the wire by trying to force down the bight, it will only spring up again. Throw the bight in a back turn (fig. F-11) and it will lie down without a struggle

Wire rope that is to be made up for a fast runoff, such as mooring lines, highlines, and various messengers, must be faked down as shown in figure F-3.

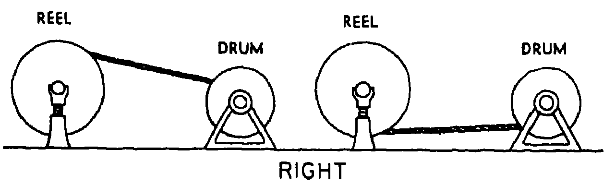

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Figure F-8.—Spooling wire rope from reel to drum.

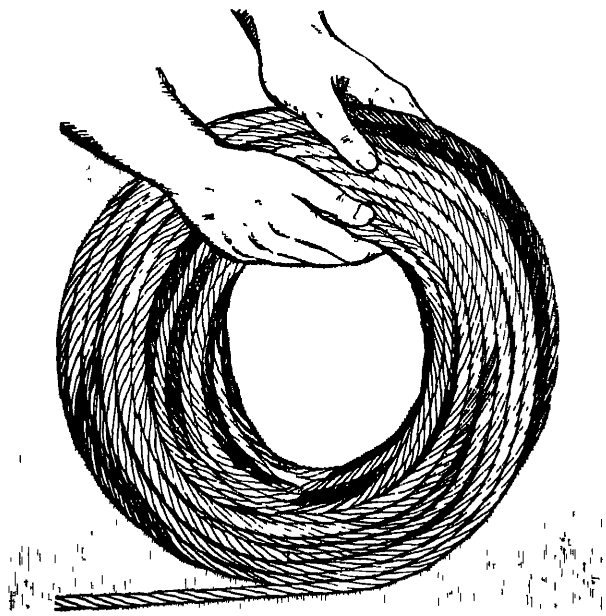

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Figure F-9.—Right way to uncoil wire rope.

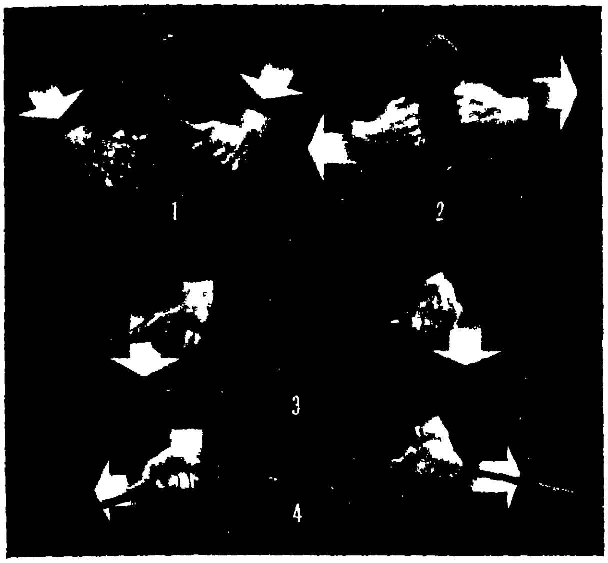

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Figure F-10.–The correct way to take out a kink in wire rope.

NYLON ROPE

ADVANTAGES AND QUALITIES

Nylon rope has several advantages over manila rope. Size for size, it is nearly three times as strong and lasts five times as long. On a strength for strength basis, a nylon line of less that half the size of a manila line is required for the same task. For these reasons, nylon is cheaper in the long run, even if its cost is greater. Because nylon does not rot or age, as does natural fiber line, its strength is more stable throughout its life. It is less bulky, more flexible, easier to handle, and requires less stowage space. Other advantages and a few disadvantages are pointed out later in this discussion.

GENERAL USAGE AND CARE

A coil of nylon rope, unlike other fiber rope, is not opened by pulling the end up through the

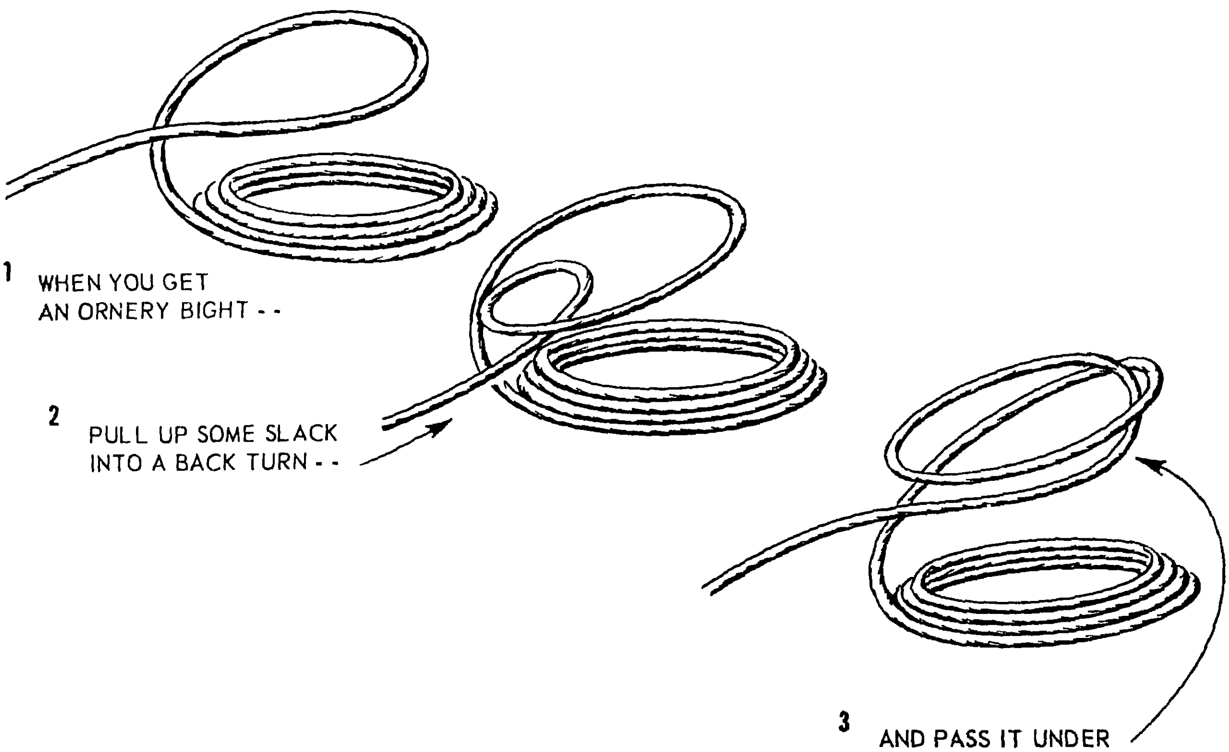

Figure F-11.–Throw an ornery bight in a back turn. 118.6

eye of the coil. It should be unreeled in the same manner as wire rope.

Normally, plain-laid nylon rope is right-handed and should be coiled on capstans and reels in a clockwise direction. Cable-laid nylon rope is left-laid and should be coiled on capstans or reels in a counterclockwise direction.

Constantly coiling twisted nylon rope in the same direction tends to tighten the twist or unbalance the lay. To end this condition, such rope, occasionally, should be coiled down against the lay. Braided nylon, having no lay, can be coiled down on a gypsy head in either direction without becoming unbalanced. One manufacturer recommends stowing braided line in a figure eight, but points out that this is not a strict requirement.

Nylon differs from other fiber rope in that it stretches under load, yet recovers to its normal size when tension is removed. With rope-laid and cable-laid nylon, a stretch of one-third its length is normal under safe working loads. A stretch of 40 percent of its length is the critical point, and it parts at 50 percent stretch. With double-braided nylon, the critical point is reached when the line is stretched 27 percent; it parts when the stretch is 30 percent. This elongation at times may be a disadvantage, but it can be halved by doubling the lines. Nylon rope can stand repeated stretching with no serious effect.

Sharp, cracking noises, caused by readjustment of the strands, are heard when applying a load to new cable-laid hawsers Wet hawsers under strain emit steamlike vapor Nylon rope that has been under heavy strain may develop glazed areas where it has worked against bitt and chock surfaces. This condition may be caused by paint or the fusing of the fibers. In either condition, the effect on the rope's strength is insignificant.

Nylon rope can hold a load even if a considerable amount of the yarns become abraided. Where such a condition is excessive but localized, the chafed section may be cut away and the ends spliced together for satisfactory reuse.

When nylon lines become iced-over in use, they should be thawed carefully at moderate temperatures and drained before stowing

If a nylon line becomes slippery from contact with oil or grease, it should be scrubbed down. Spots may be removed by cleaning with light oils, such as kerosene or diesel oil.

Do not stow nylon rope in strong sunlight. Cover it with paulins In stowage, keep it away from heat and strong chemicals.

SAFETY PRECAUTIONS

Because nylon rope, on parting, is stretched 50 percent of its length, it parts with a decided snapback. Make sure that you keep out of the direct line of pull when heavy strains are applied.

Do not use a single part of plain-laid rope for hauling or hoisting any load that is free to rotate Where one part of rope is essential, use cable-laid hawsers.

Exercise extreme care when easing out nylon line around bitts and cleats under heavy load Nylon's resistance to friction is lower than that of manila, and it may slip on easing out. For these reasons, keep an extra turn on the bitt or cleat. For holding nylon hawsers under load, employ only nylon rope stoppers Do not use wire or spring-lay rope in conjunction with nylon rope in the same chock or on bitts or bollards.

When rigging nylon or other rope for heavy strains, do not attach fairlead blocks or other equipment to padeyes or other fittings not pretested for the load. In the past, untested padeyes pulled away under heavy strain, injuring or killing men in the vicinity

Persons accustomed to the noises made while natural fiber lines are under heavy loads must be careful and train themselves to notice and rely on nylon's visible warning signs—stretching and decreases in diameter.

When nylon hawsers are employed on capstans for heavy towing or impact loading, take six turns on the capstan and two turns, over-laying the last four turns. This method reduces the hazard of sudden surges on rendering out.

WORKING WITH WIRE ROPE

Great care is exercised in the manufacture of wire rope to lay each wire in the strand and each strand in the rope under uniform tension. If the ends of the rope are not secured properly, the original balance of tension is disturbed and maximum service cannot be obtained because some strands carry a greater portion of the load than others.

SEIZING WIRE

Before cutting steel wire rope, it is necessary to place at least three sets of seizing on each side of the intended cut. Each seizing should consist of eight turns of iron seizing wire. The distance between seizings should equal the rope's diameter.

To make a temporary wire rope seizing, wind on the seizing wire evenly, using strong tension on the wire. After taking the required number of turns, as in step 1 in figure F-12, twist the ends of the wires counterclockwise, as in step 2. Grasp ends with end-cutting nippers and twist up slack (step 3). Do not try to tighten seizing by twisting. Draw up on seizing, as in step 4. Twist up slack (step 5). Repeat steps 4 and 5 if necessary. Cut ends and pound them down on the rope, as in step 6.

If the seizing is to be permanent, or the rope is 1 5/8 inches or more in diameter, use a serving bar or iron to increase tension on the seizing wire when putting on the turns.

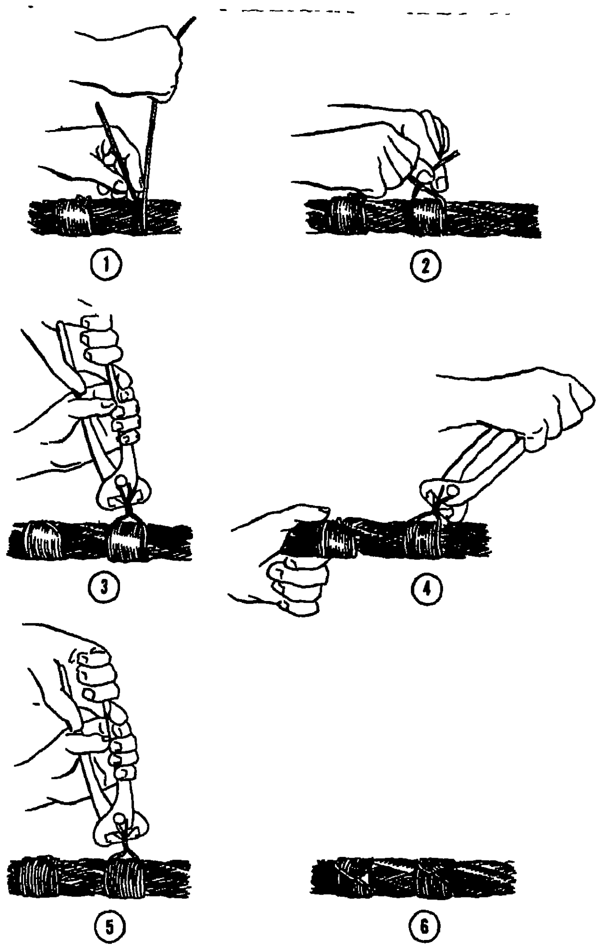

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Figure F-12.—Putting temporary seizing on wire rope.

SPLICING WIRE

When splicing wire, you may put in an eye splice or a temporary eye splice. Or you can make a short or long splice. A description of each of these splices is given in this section.

To find the distance the strands should be unlaid for an eye splice, multiply the diameter of the wire by 36 inches. Find and measure off that distance and put a seizing at that point. Another seizing should be put on just below the point where the first tuck is to be made. Next, cut off the end seizings and carefully unlay the strands. Whip the ends of each strand tightly with several turns of sial twine or friction tape. Cut out the core, form the eye, and put it in the rigger's screw or a vise, with the unlaid strands on your left. Stretch out the standing part of wire, lash it, and you are ready to go to work.

When splicing wire, always insert the marlinspike against the lay, but make sure you do not shove it through the core.

Liverpool Splice

The Liverpool splice is the most common and the easiest of the eye splices to put in wire. Never use it in a wire which, when loaded, is free to spin, because it is likely to pull out. (When

such a condition exists, use the gun factory splice.)

The first strand of the Liverpool goes under three strands, the second under two, and the third under one. They all enter at the same point, but come out at different places, as shown in figure F-13.

Strands 4, 5, and 6 are tucked, as shown in part A of figure F-14. The succeeding tucks are made by wrapping each strand back around and under the stand it is already under, as in part B of figure F-14. To avoid kinking the strands on the last tucks, insert the spike and run it up the wire, as in steps 1 and 2 of figure F-15. Follow the spike up with the strand, shove it under the spike, and pull taut. Keeping a strain on the strand, work the spike and strand back around and down together. (See steps 3 and 4, fig. F-15.) Hold the strand there and work the spike back up the wire. Follow up with the strand and take the last tuck. Work the strand back down and hold it there. Before pulling out the spike, run it back up until the strands of the standing wire, bind the working strand in place. In the same way, make the second and third tucks with the remaining strands.

After completing the third round of tucks, a locking tuck may be taken, which decreases the possibility of the splice working out. For this tuck, take every other strand (2, 4, and 6, for example) and pass each of these over two strands and tuck under the next strand.

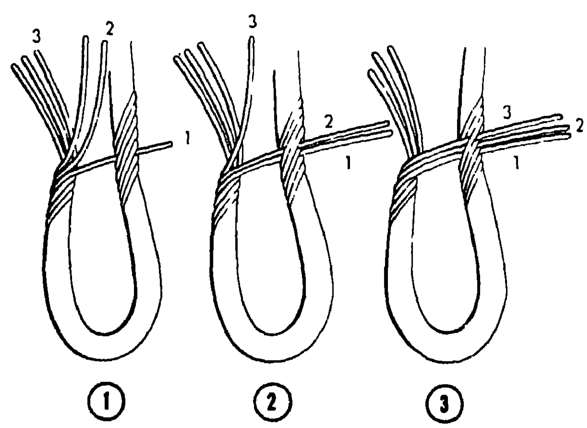

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Figure F-13.—Tucking first three strands in a Liverpool.

Short Splice

To make a short splice, you need to unlay 2 or 3 feet of each rope, depending on the size of the rope. To find the distance, apply the same formula as for the eye splice. Prepare each rope, seizing before unlaying, and whipping each strand. Interlace the strands, as with fiber rope, and then seize them. Remove one of the temporary seizings and commence tucking. Tucks go against the lay, over one and under two. Take four rounds of tucks, then split each strand and bend half of it back out of the way. The halves bent back are dropped at this point. Take two more tucks with the other halves. Next, turn your wire and repeat the foregoing steps in the opposite direction. Beat out the splice with a wooden mallet, working from the center to the ends and turning the splice as you beat. To complete the work, cut off the strands and beat down the ends.

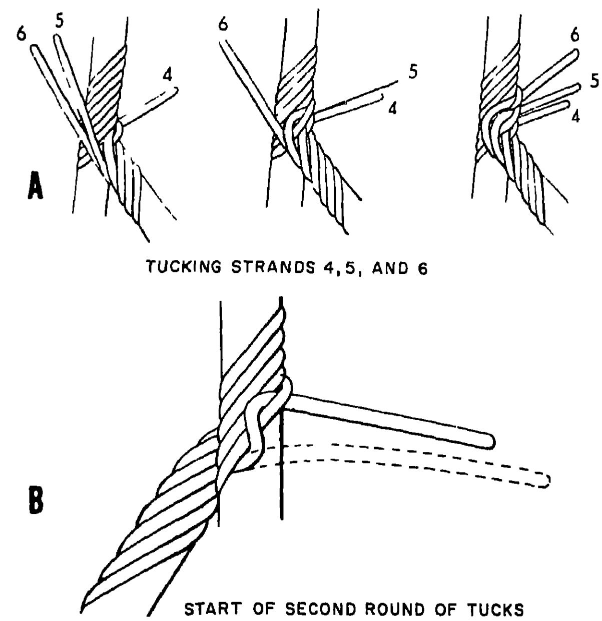

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Figure F-14.—Liverpool splice—Continued.

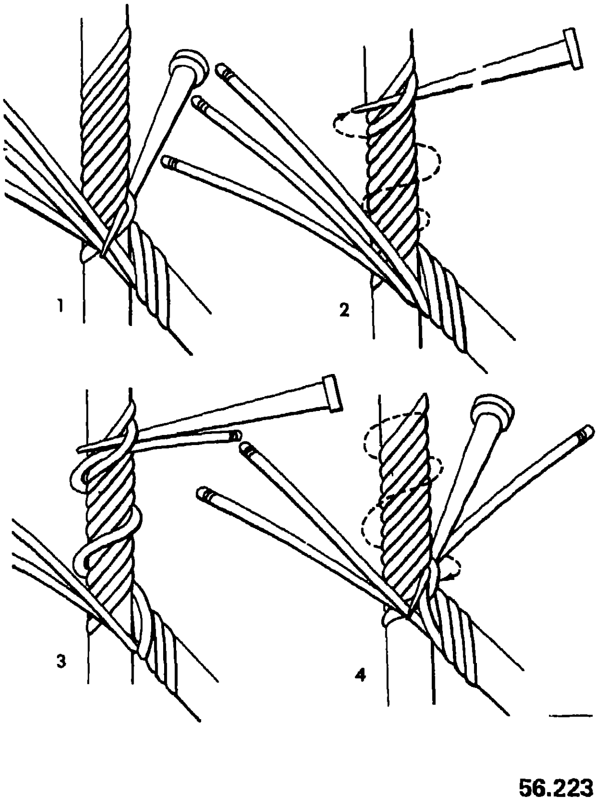


Figure F-15.–How to avoid a kink.

Long Splice

The recommended number of feet to make a long splice in wire is 40 times the diameter of the wire. In other words, a long splice in 3/4-inch wire would cover a distance of 30 feet, 1/2-inch wire would be 20 feet, and so on. For purposes of the following description, 3/4-inch wire, or a splice of 30 feet, is used.

Measure 15 feet from the ends of each wire and put on temporary seizings Cut the end seizings, unlay, and ship the strands Cut out the core, interlace the strands, and butt the ends of the rope together solidly and seize in place (See step 2 in fig. F-16.)

Step 1 Cut off the temporary seizing on one rope and start unlaying any one of the strands, laying the opposite strand from the other rope in the groove as you go. Lay in all but 2 feet of this strand and cut off all but 2 feet of the unlaid strand.

Step 2: Repeat step 1, unlaying the strand next to the strand laid in step 1. That gives you a strand laid in each direction as in step 3.

Step 3: Repeat step 1, with the next strand of the first rope, stopping 5 feet short of the meeting point of the first pair. Continue unlaying and laying in successive strands, working first one way and then the other, leaving 5-foot intervals between the meeting points. When all strands are laid in, your splice should look like that in step 4.

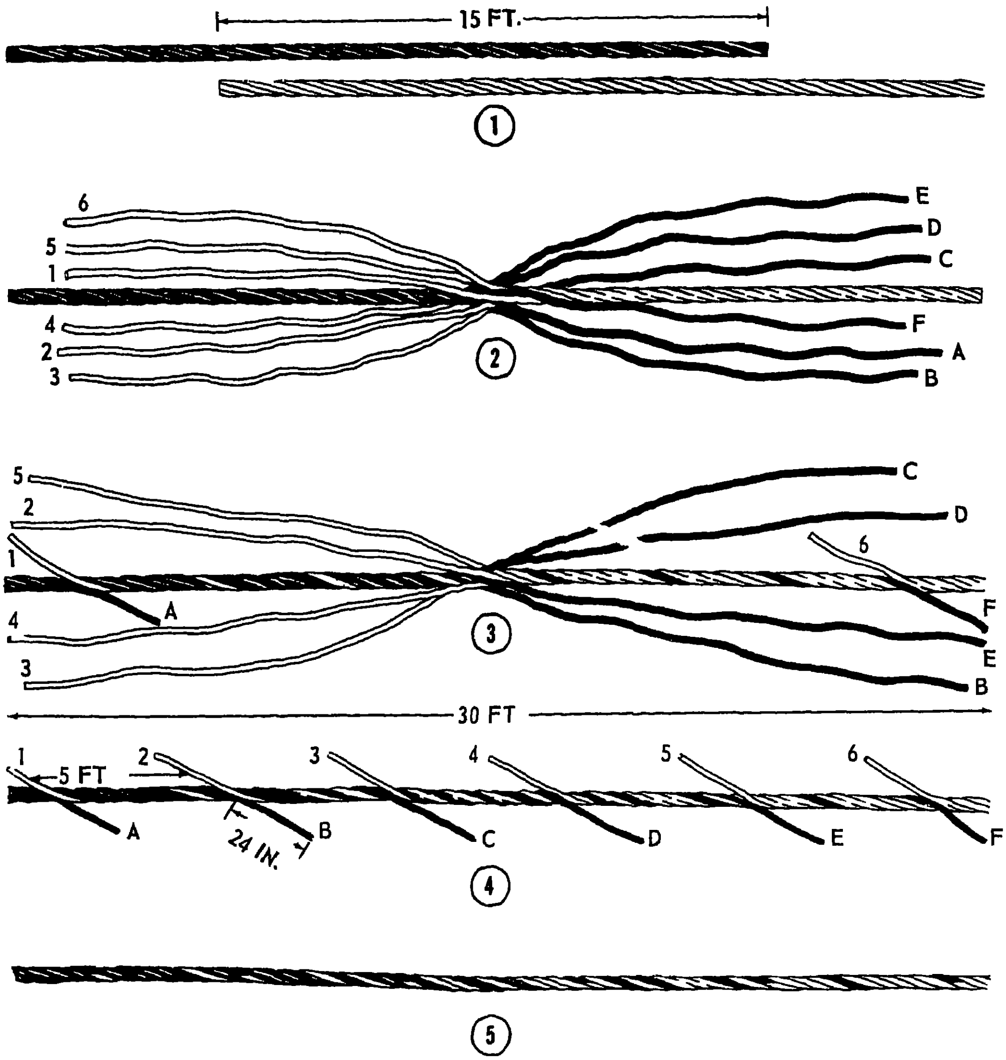
One method of securing the ends of a long splice is the same as for fiber rope. Tie an overhand knot and pull it taut. Then divide the ends in three parts and tuck them separately as shown in figure F-17.

The preferred method of securing the ends is illustrated in figure F-18. In this method, the ends of the strands are tucked into the rope, replacing the core. The strands are seized at their meeting point and the end whippings are cut off. Untwist the strands so that the "form" or "set" is taken out. Next, build up the strands to the same size as the core. This may be done with successive seizings of seizing wire if it replaces a wire core If the rope has a hemp core, serve the strands with marline or wrap them with friction tape.

Secure a Spanish windlass on each side of the meeting point, as in step 1 of figure F-18. Twist in opposite directions, opening the lay of the rope Cut the core and pull out the ends a few inches. Shove a marlinspike under two adjacent strands, as in step 2. Now you can take off the Spanish windlasses Work the spike along the rope, pulling out the core and laying in the strand until all the strand is in, then cut off the core at that point and shove the end back in place and pull out the spike. Repeat the foregoing process on all the other strand ends. Notice that the strands do not cross before tucking. After securing the ends, beat out the splice, as in step 3. A long splice, with the ends secured in the manner described, does not alter the size of the rope, and almost defies detection after the rope is used a short time.

WIRE ROPE CLIPS

A temporary eye splice may be put in wire by using wire rope clips The correct and



80.67

Figure F-16.—Making a long splice in wire

incorrect ways of using U-bolt clips are shown in figure F-19. The U-bolt always goes over the bitter end and the roddle on the standing part. Space the clips a distance apart equal to 6 times the diameter of the wire. After the rope has been under strain for an hour, the clips must be retightened as a safety measure. They are rechecked periodically thereafter and retightened as necessary. Pay particular attention to the wire at the clip farthest from the eye, because vibration and whipping are

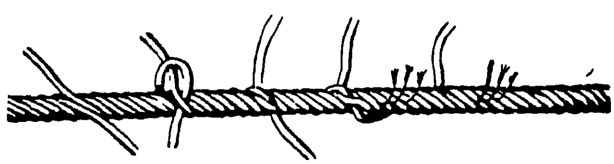


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Figure F-17.—One method of securing ends of a long splice.

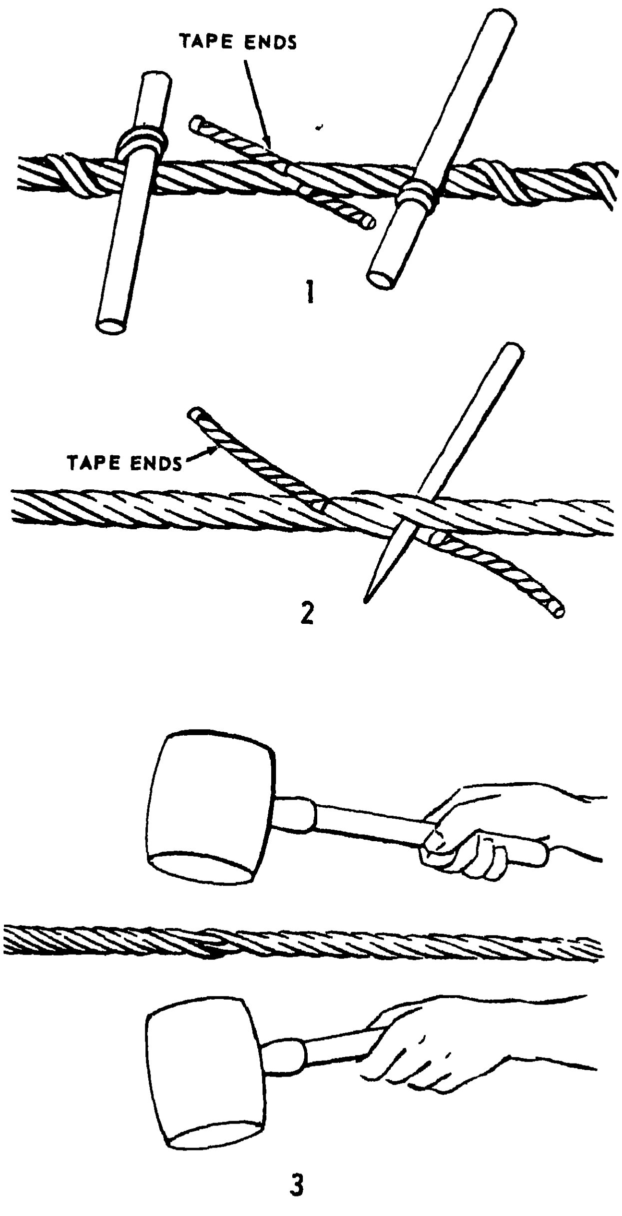

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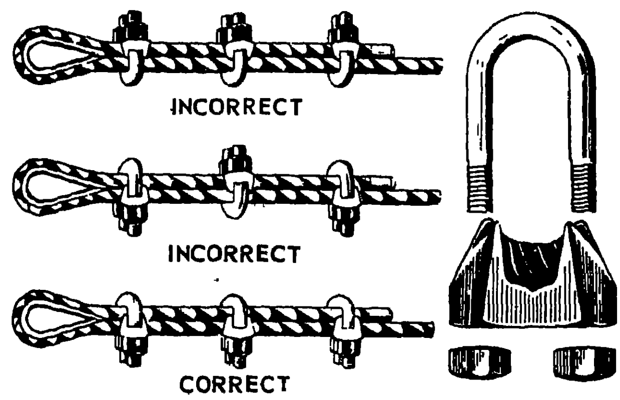
Figure F-18.—Preferred method of securing the ends in a long splice.

dampened here and fatigue breaks are likely to occur.

To obtain maximum strength in the temporary eye splice, use the correct size and number of wire clips. Size is stamped on the roddle between the two holes. The correct



56.226
Figure F-19.—The correct and incorrect use of wire rope clips.

number of clips to use for various sizes of wire rope is determined by multiplying the diameter of the rope by 3 and adding 1 (i.e., 3D + 1) Thus, for a rope 1 inch in diameter, 3D + 1 becomes 3 x 1 + 1 or 4 clips. When use of the formula results in a fraction, use the next whole number.

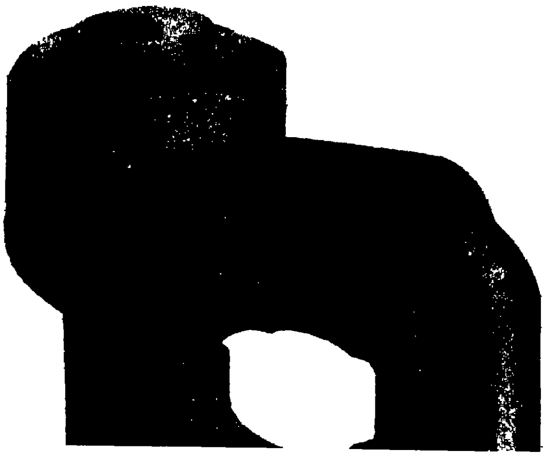
The improved type of wire rope clip shown in figure F-20 has a few advantages over that in figure F-19. Both halves are identical and provide a bearing surface for both parts of the rope. Thus, it cannot be put on wrong and it does not distort the wire. It also allows a full swing with a wrench.

Men handling wire rope must always wear gloves. Occasionally, even new wire has a fishhook that, if allowed to slide through the unprotected hand, can inflict a painful hand injury

SMALL STUFF

Line less than 1 3/4 inches in circumference is called small stuff. Its size specification is governed by the number of yarns it contains (called threads in this instance).

Line 1 3/4 inches or larger in circumference is always designated in size by its circumference in inches The Navy seldom uses line larger than 8 inches in circumference. In general, any line



80.70X
Figure F-20.—Improved type of wire rope clip.
Courtesy of U.S. Steel Corp.

larger than 5 inches utilized in towing, mooring, and similar operations is called a hawser. Remember, it is the size around (the circumference) the line that is measured, not the diameter.

To find the size of a piece of small stuff, open a strand, count the number of yarns it contains, and multiply this result by 3 for three-strand stuff. The largest small stuff is 24-thread, with three strands each containing eight yarns.

Certain small stuff, used for more or less special purposes, is designated by name, with no reference to size. Marline is the most common stuff of this type seen aboard ship. Dark brown in color, it is two-strand, left-laid, tarred hemp. It is inexpensive, fairly strong, and protected by its tarring against the weather.

Although spun yarn may be two-, three-, or four-strand stuff, the Navy uses only three-strand, left-laid, tarred hemp. It is for seizings on ships where neatness is not necessary.

Houseline is three-strand, left-laid, tarred hemp. It is for light seizings, serving pennants, rigging, and outside work exposed to weather.

Roundline is three-strand, right-laid, tarred hemp. It is used for seizings and servings on ships where neatness is required.

Seizing stuff is small stuff laid up right-handed by machine, like regular line, but is not much larger than fishing line It is used for servings when a fancier job than can be done with marline is desired.

Ratline stuff is used mainly for snaking. It is three-strand, right-laid, tarred hemp, coarsely made and laid up like regular line.

Cod line is the light, white line formerly utilized in hammock clews (lines for suspending a hammock). It now is used for decorative purposes.

Rope yarns for temporary seizings, whippings, and lashings are pulled from large strands of old line that has outlived its usefulness. Pull your yarn from the middle, away from the ends, or it may get foul. Keep an old strand, about a fathom long, hanging in the boatswain's locker for this purpose.

KNOTS

Among seamen, the term "knot" must give way to its more specific meaning and to the terms "bends" and "hitches." In addition, seamen must know which knot, bend, or hitch will serve best in a particular case.

First and foremost, a good knot must hold fast without slipping. Next, if it is a knot in general use and not an ornament, it should be easy to tie. The best knot is one that has all these advantages and is easy to untie as well.

A bowline is a good knot—one of the best—but is worthless for mooring to a spar. You cannot use a clove hitch on a boatswain's chair.

In the small group of knots described in this section, you will find every knot needed around the decks, together with an idea of the uses to which each may be put.

BENDING TWO LINES TOGETHER

According to a seaman's use of the term, in a knot, the line usually is bent to itself. The knot forms an eye or knob or secures a cord or line around an object, such as a package.

A bend, ordinarily, is used to join two lines together. The square knot, also called the reef knot, is the best-known knot for bending two lines together.

A landsman trying to tie a square knot often comes out with a granny, so called because it is the kind of slippery hitch dear old grandma would tie. For a square knot, both parts of the line must be under the same bight. If one is up and the other down, you have a granny knot, which is of no use to any seaman. Figure F-21 shows how to get a square knot every time. A square knot is a good knot, and cannot slip. It can jam on a strain, however, and be very difficult to untie.

Here is the proper procedure for tying a square knot Take the end in your right hand, say to yourself "over-under," and pass it over and under the part in your left hand, as illustrated. With your right hand, take the end that was in your left, say to yourself this time "under-over," and pass it under and over the part in your left hand.

A becket bend, considered as good a knot as the square knot, is much easier to untie after a strain. It is especially good for bending together two lines of different sizes. Figure F-22 details the steps in tying a becket bend, single or double. A double becket bend is always used to bend the gantline (riding up and down line) onto a boatswains chair.

A single carrick bend has no advantage over a square knot or becket bend, and jams hard on even a light strain. A double carrick bend, with ends seized down, comes apart readily after the heaviest kind of strain, for the simple reason that it never draws up. Towing hawsers are bent together with a double carrick. Do not forget: If the ends are not seized down, the knot draws up and jams. Figure F-23 illustrates a double carrick bend.

Two bowlines, tied as described later, is a method of quickly bending two lines together by tying bowlines around each. The sharp turns of the lines, where they cross one another, however, causes the bowlines to part much sooner than if bent with a square knot or becket bend.

KNOTS TO FORM A LOOP OR EYE

The bowline (fig. F-24) is the standby for putting a loop in the end of a line. It neither slips nor jams, yet unties easily A bowline is the

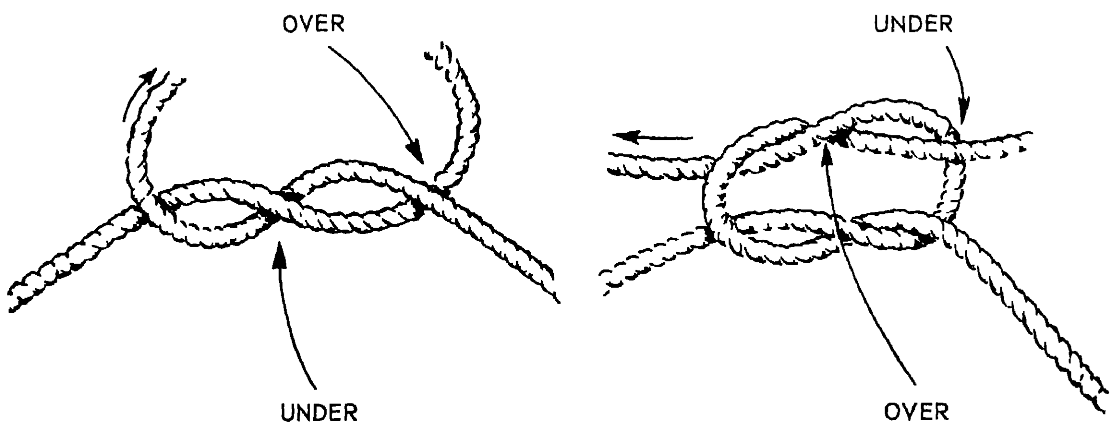


Figure F-21.—Get a square knot every time.

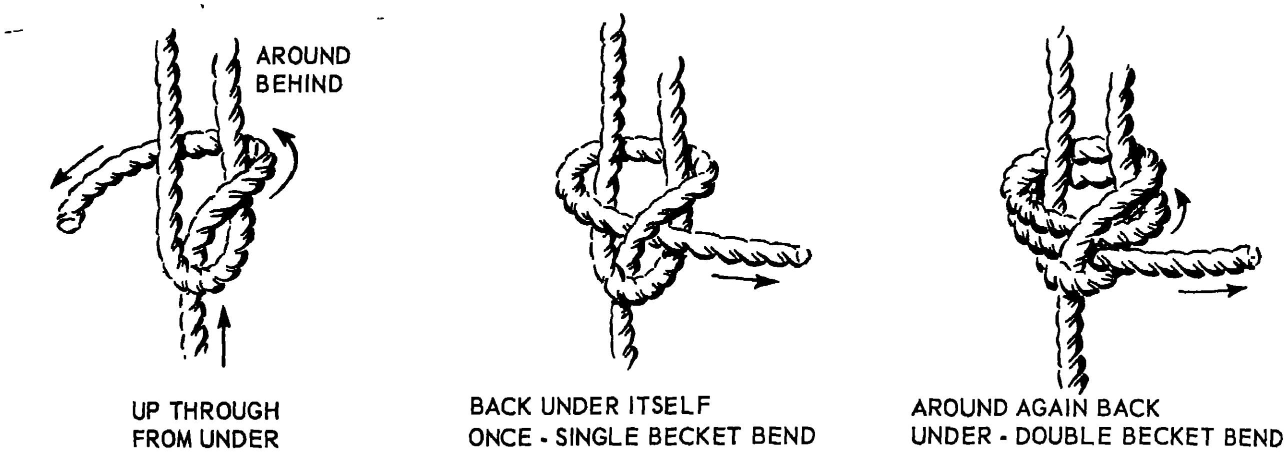


Figure F-22.—Tying single and double becket bends.

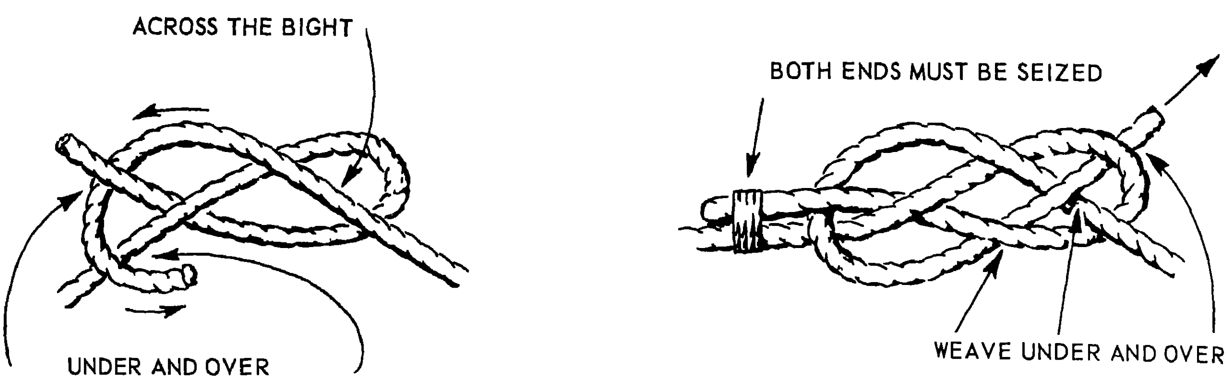


Figure F-23 —Double carrick bend

best knot to use for bending a heaving line or messenger to the eye of a hawser because it is quick to tie and easy to get off.

A bowline on a bight gives two loops instead of one, neither of which slips It is used to hoist a man, chair-seat fashion, out of a lifeboat or hold. Figure F-25 shows you how to tie a bowline on a bight. As you can see, you start with your line doubled.

A French bowline has the same purpose as a bowline on a bight. It gives you two loops that can be adjusted to fit. Adjust one of the loops under a man's hips, the other under his armpits, and draw tight with the knot at his chest Even an unconscious man can ride up safely in a properly secured French bowline, if you take care not to allow the part under the man's arms to catch on anything A step-by-step example of making a French bowline is given in figure F-26.

A running bowline is merely a slipknot or a lasso A knowledge of this knot is valuable, for you might have to throw a noose around a bollard on the dock sometime. Just tie a small bowline around your line's standing part, slack enough to run freely.

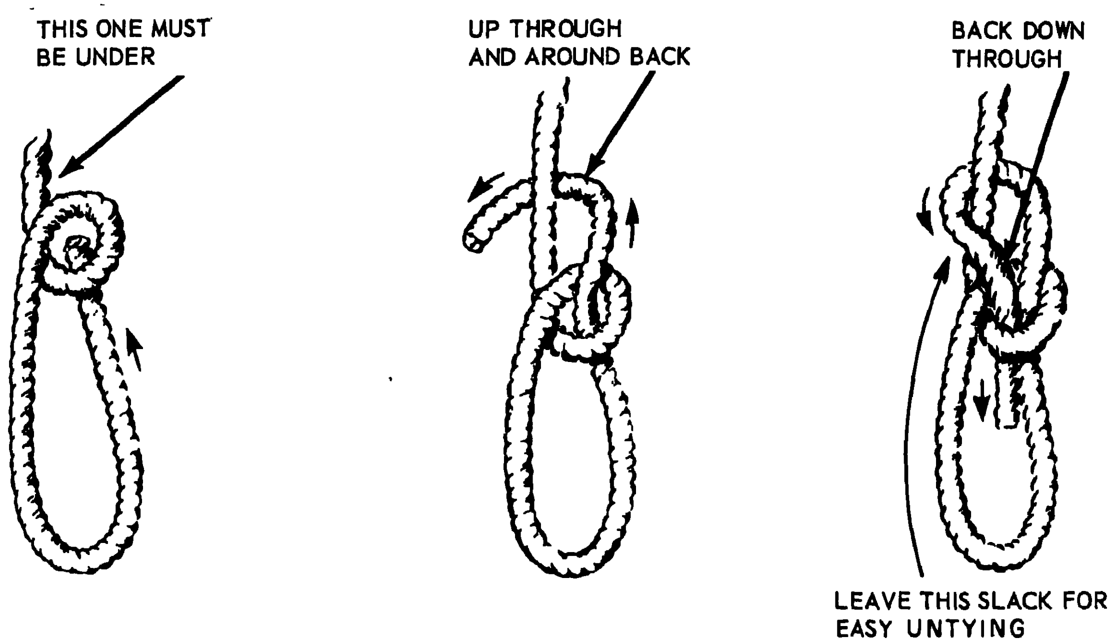


Figure F-24.–Tying a bowline. 3.218

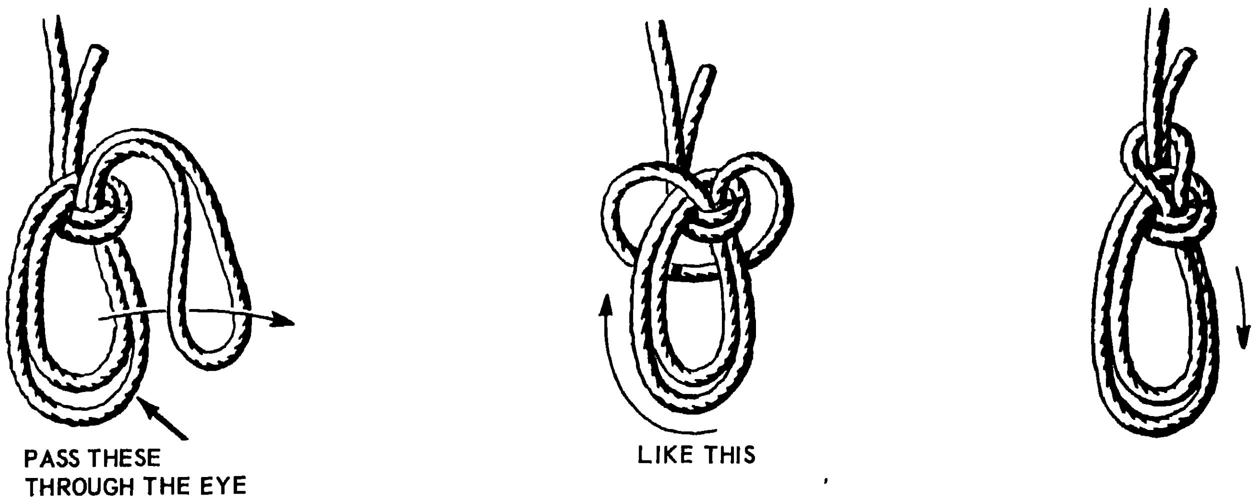


Figure F-25.–Bowline on a bight. 80.27

BENDING TO A RING OR SPAR

In securing a line to hook, ring, or spar, you can employ the method known as hitches. Various hitches are described in the following topic.

Hitches

A hitch differs from a knot in that it ordinarily is tied to a ring, around a spar or stanchion, or around another line. In other words, it is not merely tied back

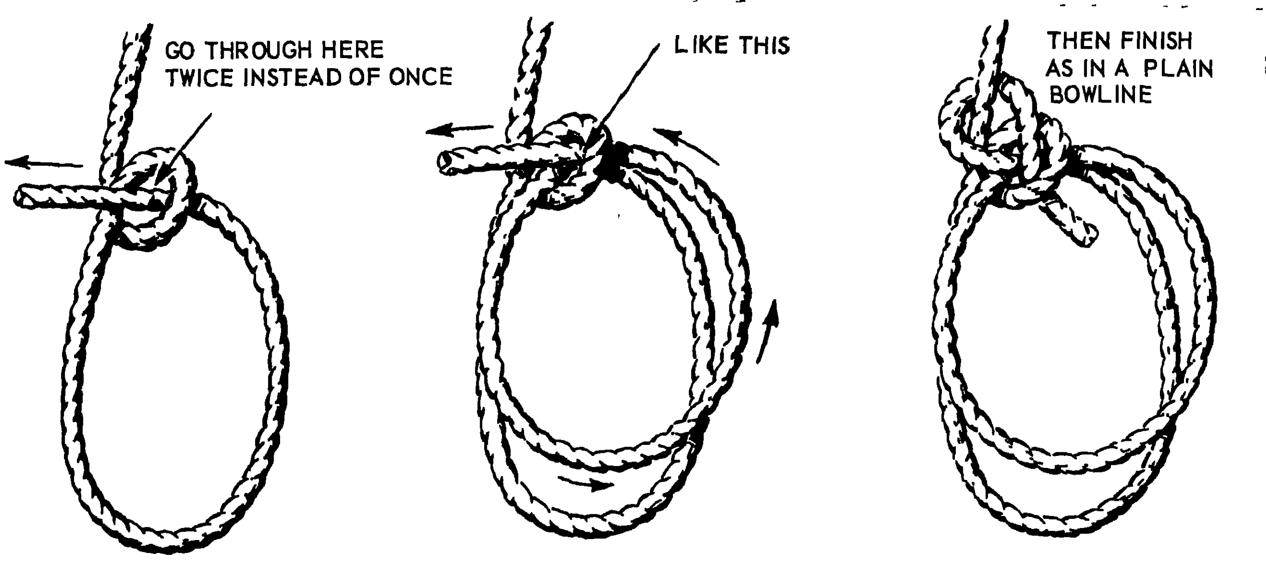


Figure F-26.—Tying a French bowline.

on itself to form an eye or to bend two lines together.

The rolling hitch is one of the most useful and most important hitches on deck. Use it for passing a stopper on a boat fall or mooring line when shifting the fall or line from winch or capstan to cleat or bitts. It also may be used to secure a taut line back on itself. If tied properly, it holds as long as there is a strain on the hitch.

When tying, take a turn around the line with the stopper, as in view 1 of figure F-27. Pull taut, then take another turn This turn must cross over the first (view 1) and pass between the first turn and the stopper (second view) The rolling hitch itself is not complete, but it must be stopped off in one of several ways.

You may take two or more turns with the lay of the line and then marry the stopper to the line by hand or seize the stopper to the line with marline. Another method is to tie a half hitch directly above the rolling hitch. A third method is to tie a half hitch about 1 foot above the rolling hitch (view 3), then take a couple of turns against the lay, and marry or seize the stopper to the line.

The best knot for bending to a ring, spar, or anything else that is round or nearly round, is a clove hitch. This is such a fine knot that the oldtime seamen used to call a man who was worth his salt "all in a clove hitch " Figure F-28 shows you how to throw one.

A clove hitch will not jam and can never pull out A slack clove hitch, as on a boat painter, however, might work itself out For that reason, it is a good idea to put a half hitch in the end, as in figure F-29 A half hitch, by the way, never becomes a whole hitch. Put another one on, and all you have is two half hitches, as shown

The slight defect a clove hitch might have is that it can slide along a slippery spar when the strain is along the spar The knot that cannot slide this way is the stopper hitch (fig. F-30) This knot is especially useful for bending a boat painter to a larger line whose end is unavailable. It jams tight on a hard strain, however

SPLICES

When your bend or loop is to be permanent, splice your lines together or put in a loop with an eye splice.

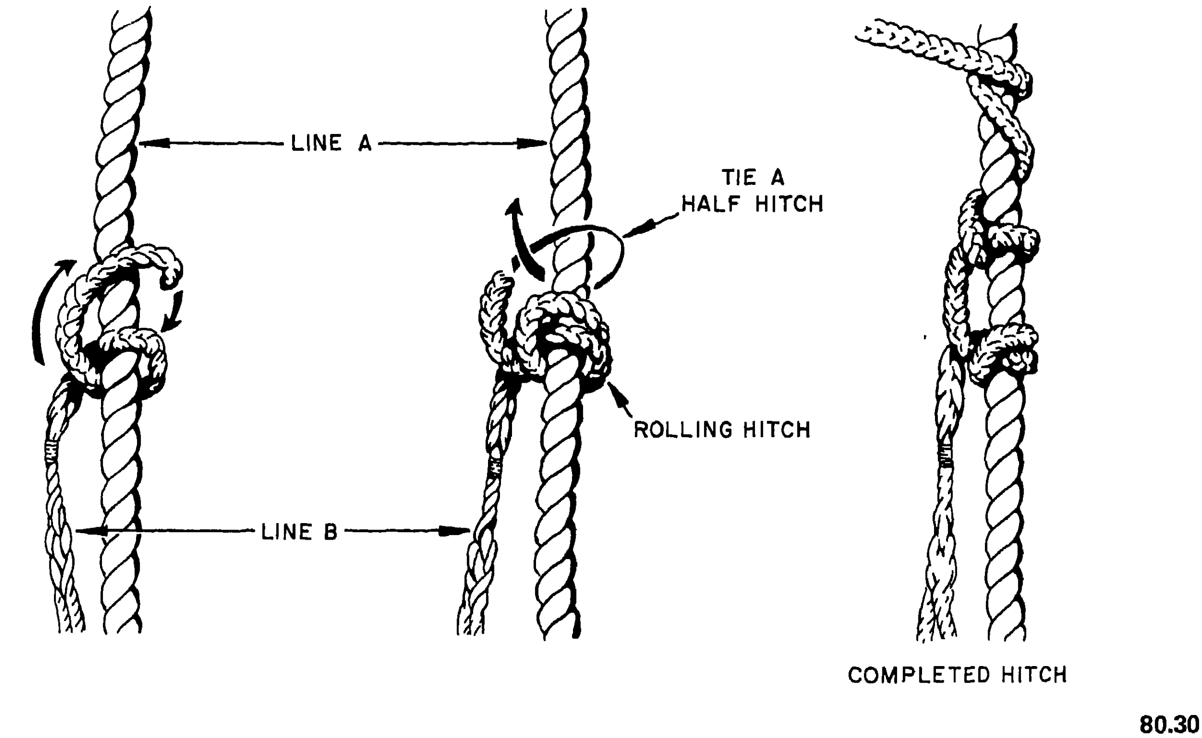


Figure F-27.–Rolling hitch.

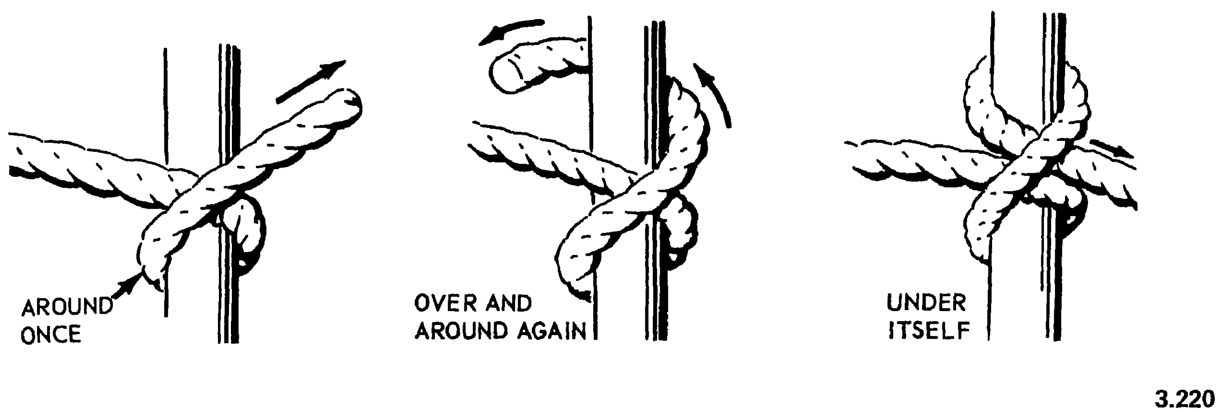


Figure F-28.–Throwing a clove hitch.

EYE SPLICE

To make an eye splice, unlay (untwist) the strands in the end of your line as far as you think necessary, and splice them into the standing part of the line by tucking the unlaid strands from the end into the standing part. Learn to estimate the length of line you need to unlay for your complete splice so that you will not finish short or waste a lot of line by cutting it off. An original round of tucks, plus two more complete rounds, is enough for an ordinary eye splice.

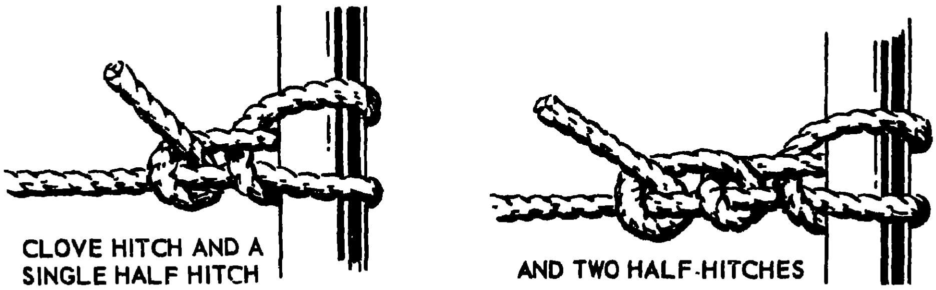


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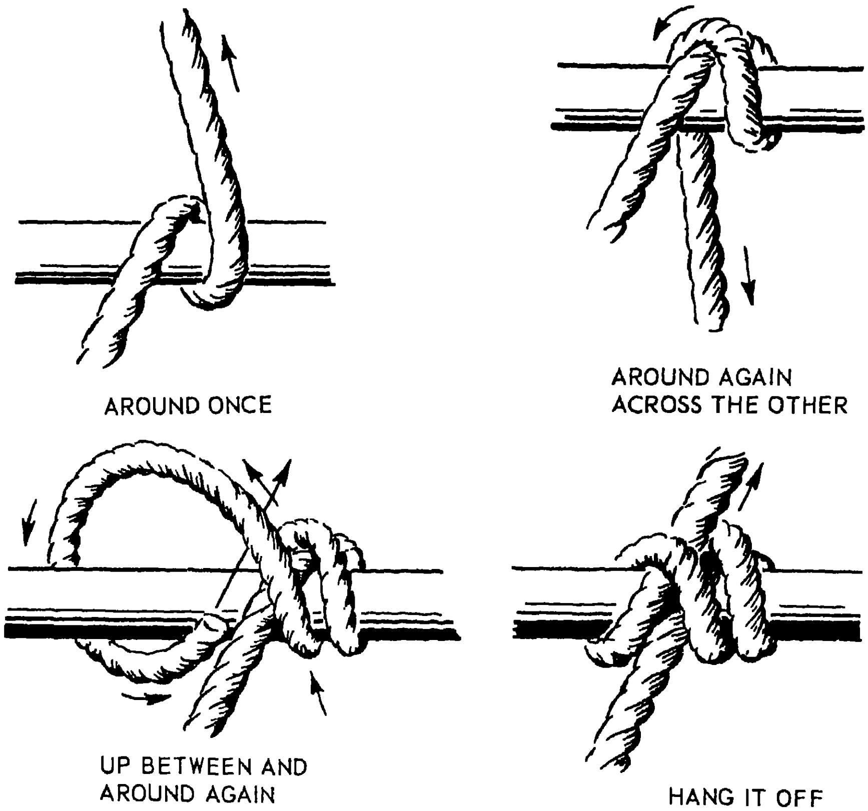
Figure F-29.—Clove hitch and two half hitches.



118.13

Figure F-30.—Stopper hitch.

With large lines, you must whip the ends of the strands before you start, otherwise they will frazzle out and be troublesome. Large lines also must be seized at the point where unlaying stops, or you will have trouble working them. With any line up to about 2 inches, you can open the strands in the standing part with your fingers. The fid must be used for larger lines.

Figure F-31 illustrates the knack of working the fid in making an eye splice. Lay out your

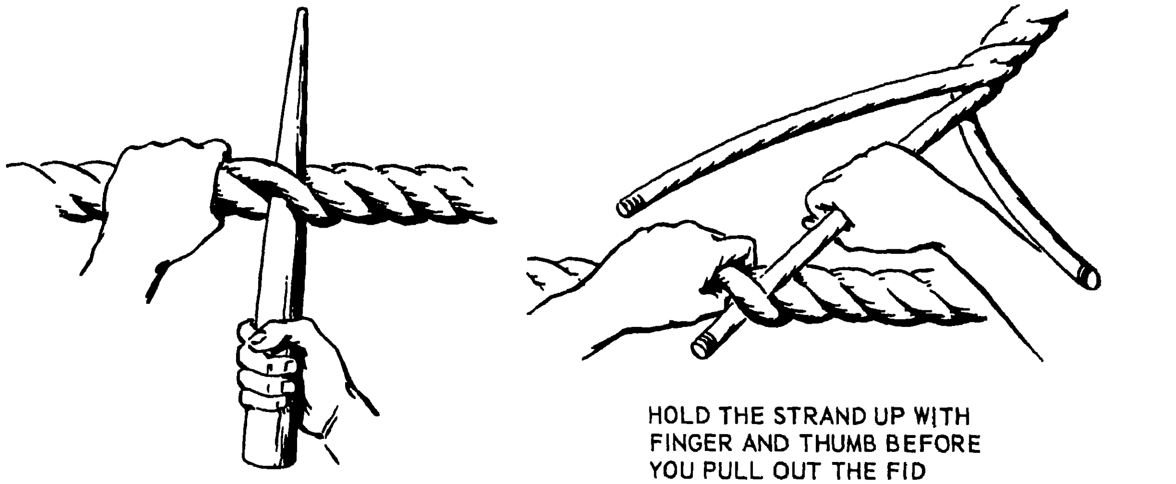


Figure F-31.—Working the fid.

line along the deck with the end to your right Bend it back until the eye is the right size, and shove the fid through the standing part at the correct spot to raise the top strand. With your right hand, shove the fid through, away from you, holding the line with your left hand. Grab the raised strand with your left index finger and thumb, and hold it up while you pull out the fid. Drop the fid, pick up the proper strand in the end, and tuck it through the raised strand from outboard toward you

Your first round of tucks must be taken in proper order to avoid getting fouled up Separate the strands in the end and hold them up as indicated in the first view in figure F-32 The middle strand (facing you) ALWAYS tucks first. Be sure to keep the right-hand strand, in the second view, on the side of the line that is toward you Tuck that one next, OVER the strand you just tucked the other one under, and under the strand just below it

Now turn the whole thing over. In the fourth view you can see that you now have only one strand from the end left untucked, and only one strand in the standing part that does not already have a strand under it. Do not forget to tuck the last strand, also from outboard, toward you.

The first round of tucks is the key to making perfect eye splices, the rest is easy. Simply tuck each strand from the end over the strand of the standing part that it is now above, and under the next strand below that one, until you tuck each strand two times, in addition to the original tuck. Three tucks to each strand is enough.

SHORT SPLICE

Lines are short-spliced together when a slight enlargement of the diameter of the line is a matter of no importance. Slings are made of pieces of line, with their own ends short-spliced together

The only trick to short-splicing is in seizing the ends together (see fig F-33) so that each strand in one end lies along a corresponding strand in the other end. After unlaying the strands, you simply butt the two ends against each other until you see that they are interlaced correctly.

With large lines, you now must put on a temporary seizing where they join to keep them from suddenly coming apart. It is better to do that with small lines, too, until you get the hang of holding them together while you tuck.

Once your seizing is on, tuck over and under the same way you finish off an eye splice. Three tucks on either side of the seizing are ample.

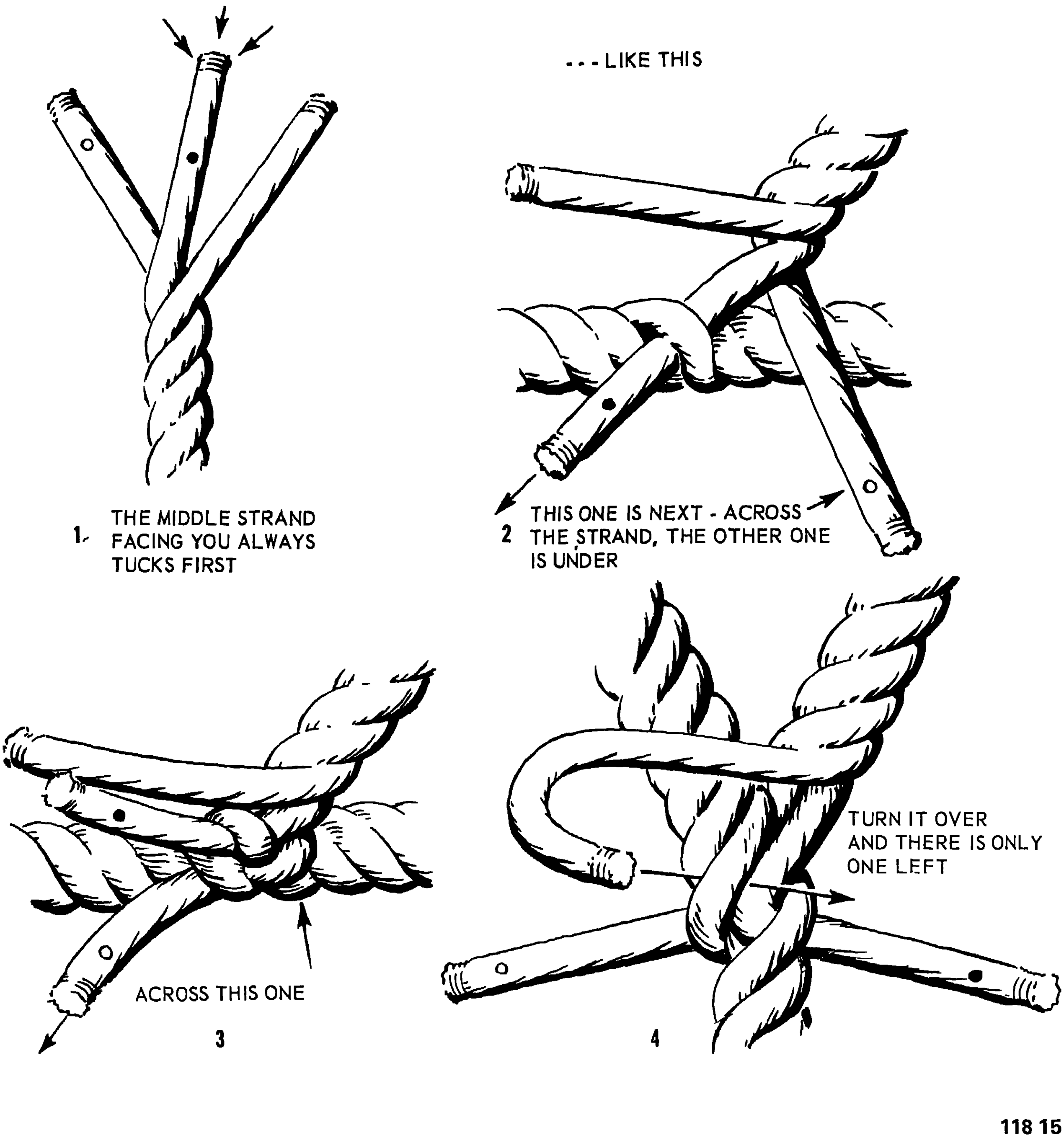


Figure F-32.—Making an eye splice.

DECK SEAMANSHIP

In the U.S. Navy, ships are classified as either combatant (warships) or non-combatant (cargo ships, oilers, etc.). The organization of the ships company is different for these two types of ships. Usually, a combatant ship has a weapons department headed by the weapons officer. He is responsible for the care and preparation of the ships weapons. These include

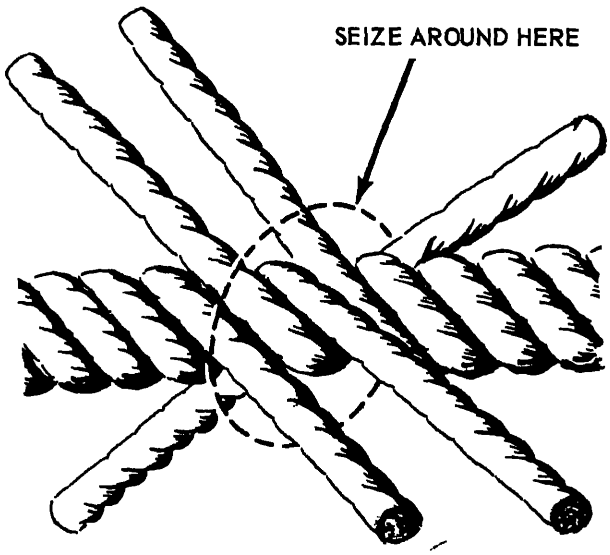


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Figure F-33.—Seize lines for splicing.

nuclear weapons and other armament and ordnance equipment. He is also responsible for deck seamanship operations. These include the care and maintenance of cargo equipment, ground tackle, and other equipment To help the weapons officer in his deck responsibilities, the First Lieutenant is assigned as his assistant.

HEAD OF THE DEPARTMENT

On a combatant ship, the weapons officer has many duties and responsibilities. These include

Training and direction of personnel.
Upkeep of department repairs.
Planning of deck work.
Anchoring operations.
Mooring operations.
Refueling and replenishment at sea
Controls supplies
Painting of ships exterior.
Procurement of ammunition.
Maintenance and repair of ships weapons.
Handling and stowage of ammunition

There are other duties, but these give an idea of the weapons officer's responsibilities.

On noncombatant ships, such as those used for service or amphibious operations, there is no weapons officer. Instead, the first lieutenant is assigned as the head of the deck department. One exception to this general rule is the fact that aircraft carriers have both weapons and deck departments. On these noncombatant ships, the first lieutenant is assisted by a weapon/gunnery officer. He is responsible for all duties relating to ordnance. The duties of the first lieutenant on noncombatant ships are the same as those listed above for head of a weapons department.

With respect to seamanship, the first lieutenant is responsible for all of the work performed by the deck divisions. For example, one of these duties is the upkeep of the exterior of the ship Another duty is the operation, care, and maintenance of the ground tackle, mooring lines, and related equipment. Before entering port, he insures that the ground tackle and mooring lines are ready for use. When anchored, he keeps himself informed as to the condition of the ground tackle. He promptly informs the commanding officer when any corrective action is needed. When made fast to a pier, he insures that the lines are properly watched in case of changes in weather, tides, and currents. The first lieutenant is also responsible for the operation, care, and maintenance of the life rafts and other lifesaving equipment and the ship's boats. The first lieutenant insures that adequate means for securing the ship's boats are provided and used. He makes sure that the required life jackets and other standard safety equipment is in place and in good condition. When at sea, he insures that a supply of fresh water provisions are in the boats or attached to the life rafts or similar lifesaving equipment Still another responsibility of the first lieutenant is the operation, care, and maintenance of the towing gear, rigging, gangways, fueling and provisioning at sea gear, and other deck fittings. When at sea, he insures that all gear about the weather decks is properly secured and ready for use. All matters related to deck seamanship, including those involved in loading, unloading, and stowage of cargo, fall within his duties. To help him perform his duties, the first lieutenant has a group of men which numbers approximately 30 on a destroyer and 75 on a frigate. As a department head on an

oiler, he has about 100 men, and on a carrier he has around 450 men.

DECK DEPARTMENT PERSONNEL

Those persons under the first lieutenant carry out all seamanship functions aboard ship. They are members of one of the deck divisions within the weapons/deck department. On a small combatant ship, such as a destroyer, these men are in a single division, known as the first division. On larger ships, such as cruisers, amphibious and service force ships, these men are in a number of divisions (as many as nine on an aircraft carrier). For instance, ships larger than a destroyer will have a second division carrying out the seamanship functions as they apply in the after half of the ship. The first division maintains the foward half of the ship. Ships having a large number of boats will have a division whose primary function is the upkeep of the boats The total number of deck divisions a ship has and the way they are designated by number (first, second, third, etc.) depends on ship type and size.

Those personnel performing seamanship work aboard ship under the first lieutenant are of two general personnel classifications—seaman (SN) and boatswain's mate (BM).

SEAMAN

The seaman apprentice (SA), reporting aboard ship from boot camp, is assigned to one of the deck divisions. These men perform the physical work which is the responsibility of the first lieutenant. This will include maintenance of certain ship's compartments, decks, and deck equipment In addition to this physical work, the seaman stands deck watches. These include watches such as helmsman, lookout, messenger underway and in port, anchor, sentry, and other special watches. The seaman also mans and operates small boats, booms, cranes, and winches. Finally, during condition I at general quarters, seamen act as members of gun crews and damage control parties.

Before a seaman apprentice can strike, or try to obtain advancement to a general rating, such as signalman, gunner's mate, boatswain's mate, etc., he must first satisfy the requirements for seaman. To qualify for advancement to seaman, the seaman apprentice must perform a large number of tasks concerned with marlinspike, deck, and boat seamanship. He must also show certain knowledge of rules of the road, duties of members of a gun crew, cargo handling, clerical procedures, military etiquette, and safety. A partial listing showing the tasks required for advancement to seaman is given below.

SEAMAN (SN)

20 SAFETY

20252 IDENTIFY SIGNAL FOR MAN OVERBOARD AND PROCEDURE FOR REPORTING MAN OVERBOARD

20253 MAINTAIN LIFESAVING EQUIPMENT

29 MECHANICAL MAINT/OPERA-ORD EQUIPMENT

29216 PERFORM FUNCTIONS OF SIGHTSETTER, POINTER, AND TRAINER IN LOCAL AND AUTOMATIC CONTROL

29217 INTERPRET THE COMMANDS STATION, LOAD, COMMENCE FIRING, CHECK FIRING, RESUME FIRING, CEASE FIRE, AND SILENCE

29345 DISTINGUISH ARMOR-PIERCING AND TRACER AMMUNITION BY FIXED, SEMI-FIXED AND SEPARATE LOADING USING PAINT MARKINGS AND NOTING THE CHARACTERISTICS OF EACH

29346 IDENTIFY PARTS OF A SHELL

29347 IDENTIFY FUNCTIONS OF A PRIMER AND A FUZE

29348 HANDLE AND STOW AMMUNITION

SEAMAN (SN)

34 SEAMANSHIP

34311 PERFORM THE FOLLOWING·
A. HEAVE A HEAVING LINE
B. COIL-DOWN, FAKE-DOWN, AND FLEMISH-DOWN A LINE
C COIL-DOWN AND FAKE-DOWN A WIRE

34313 DETERMINE SIZE OF LINE AND WIRE

34314 APPLY TEMPORARY AND PERMANENT WHIPPING ON A LINE, PUT A SEIZING ON A WIRE

34315 TIE A BOWLINE ON A BIGHT, ROLLING HITCH, AND CLOVE HITCH, PASS A STOPPER, MAKE AN EYE SPLICE AND SHORT SPLICE, TIE A CARRICK BEND

34316 RIG A GANTLINE TO A BOATSWAIN'S CHAIR AND A STAGE FOR SELF-LOWERING

34317 IDENTIFY FUNCTIONS OF GROUND TACKLE EQUIPMENT, BITTS, CHOCKS, TOWING PADS, CLEATS, AND LEADMAN'S CHAINS, BINNACLE, RUDDER ANGLE INDICATOR, ENGINE SPEED INDICATOR, AND ENGINE ORDER TELEGRAPH

34320 MAINTAIN NATURAL AND SYNTHETIC FIBER LINE, AND WIRE ROPE

34321 IDENTIFY FUNCTIONS OF ANCHOR WINDLASS, BOAT BOOMS, ACCOMMODATION LADDERS, WINCHES, CRANES, CAPSTANS, AND DAVITS

34322 IDENTIFY TYPES OF SHIP ANCHORS

SEAMAN (SN)

34 SEAMANSHIP–Continued

34323 REPAIR AND MAINTAIN CANVAS

34324 HEAVE A LEAD LINE AND IDENTIFY MARKINGS

34325 IDENTIFY SHIP'S CALL BY FLAG HOIST AND SIGNAL LIGHT

34326 IDENTIFY NAVY SMALL CRAFT

34327 PERFORM FUNCTIONS OF BOWHOOK, STERNHOOK, AND BOATKEEPER IN A BOAT

34328 ASSIST IN HOISTING AND LOWERING A BOAT

34329 RECOGNIZE BOAT HAILS, RECALLS, AND SALUTES

34330 INTERPRET PROCEDURES FOR BOAT HANDLING IN HEAVY SEAS

34331 PERFORM ANCHORING AND DOCKSIDE MOORING OF A BOAT

34332 IDENTIFY EQUIPMENT USED IN REPLENISHMENT AT SEA

42 GENERAL WATCHSTANDING

42241 STAND WATCH AS.
A MESSENGER
B. SIDE BOY
C. LOOKOUT
D. HELMSMAN AND LEE HELMSMAN
E. ANCHOR WATCH
F FOG WATCH
G. LIFEBOAT CREW MEMBER
H TELEPHONE TALKER
I OFFICE TELEPHONE WATCH

SEAMAN (SN)

47 NAVIGATION SUPPORT (SHIP OPERATIONS)

47001 IDENTIFY STANDARD COMPASS, STEERING COMPASS, MAGNESYN COMPASS, GYRO REPEATER, AND PELORUS

47002 LOCATE AND TURN ON SHIP DECK AND INTERIOR STANDING LIGHTS

47003 IDENTIFY DIFFERENCES BETWEEN MAGNETIC COMPASS, GYRO COMPASS, AND MAGNESYN COMPASS

47004 IDENTIFY DIFFERENCE BETWEEN BEARING BY DEGREES AND BEARING BY POINTS

47005 STEER BY COMPASS AND ENTER DATA IN COMPASS COURSE BOOK

47006 IDENTIFY BASIC RULES OF THE ROAD FOR DETERMINING BURDEN AND PRIVILEGE FOR AVOIDING COLLISION IN MEETING END-ON, CROSSING, AND OVERTAKING SITUATIONS; REQUIREMENTS OF RULES OF THE ROAD FOR, AND CHARACTERISTICS OF, RUNNING AND ANCHOR LIGHTS

47007 IDENTIFY VISUAL AND SOUND SHIP DISTRESS AND BREAKDOWN SIGNALS ACCORDING TO INTERNATIONAL AND INLAND RULES OF THE ROAD

47008 IDENTIFY CHANNEL BUOYS, OBSTRUCTION BUOYS, AND MIDCHANNEL OR FAIRWAY BUOYS IN U.S. WATERS

47009 COMPUTE GREENWICH CIVIL TIME

SEAMAN (SN)

94 MECHANICAL MAINTENANCE

94366 LUBRICATE AND PRESERVE STANDING RIGGING, BLOCKS, PELICAN HOOKS, TURN BUCKLES, FALLS, AND WEATHER DECK EQUIPMENT

94367 USE WEEKLY SCHEDULE (3-M) FOR DETERMINING MAINTENANCE ASSIGNMENTS

When a man makes seaman, he has demonstrated a lot of knowledge, and is capable of performing many jobs required in the operation of a ship.

BOATSWAIN'S MATE

The boatswain's mate in the deck division is a supervisor He is responsible for directing and training the seamen in his charge He trains them in their military duties and in all activities relating to marlinspike, deck, and boat seamanship This includes directing the operation and maintenance of deck equipment, boats, rigging, and the ship's external structure. The boatswain's mate may act as petty officer in charge of gun crews and damage-control parties during general quarters Underway, he stands boatswain's mate of the watch on the bridge and in port petty officer of the watch on the quarterdeck During replenishment and refueling operations underway, boatswain's mates fill most of the key jobs at the transfer stations

Because the boatswain's mate aboard ship is a supervisor, he has a large influence on his men. Few other petty officers are charged with training and working with so many of the new men reporting aboard ship. It is in the deck division that many men receive their first impressions of shipboard life. The day-to-day work done by the deck divisions varies with the weather, ship's training requirements, and operating schedule. In general, it is hard work. It is often routine, and sometimes dangerous. At sea, the hours are long and most of the work is outside. The life of a deck seaman is very

demanding and the leadership shown by the boatswain's mates is important to the deck division's morale.

Like the seaman apprentice, the seaman must show that he can perform the tasks required of his chosen rating before he can advance to the next higher pay grade, E-4. There are many ratings open to a seaman. Some of these are signalman, radarman, and gunner's mate. Many of the seamen in the deck division will strike for one of these ratings as they become eligible. Some seamen choose to stay in the deck force and strike for boatswain's mate To qualify for advancement to boatswain's mate, third class (BM3), the seaman must show practical and knowledge factors in supervision cargo handling, damage control, gunnery, shiphandling and piloting, painting, deck seamanship, small craft, and safety. A list of some of the tasks is given below. These show the minimum degree of performance required for advancement to E-4 in the boatswain's mate rating.

BOATSWAIN'S MATE THIRD CLASS (BM3)

11 DAMAGE CONTROL

11511 LOCATE DAMAGE-CONTROL FITTINGS AND EQUIPMENT

16 ORDNANCE AND MISSILE HANDLING

16061 SERVE AS GUN CAPTAIN

16063 PERFORM ELEMENTARY FIRE CONTROL INCLUDING ESTIMATING TARGET RANGE AND SPOTTING

30 MECHANICAL MAINT/OPERATION-AUXILIARY EQUIPMENT

30051 OPERATE DECK WINCHES, TWO WINCHES SIMULTANEOUSLY IN YARD AND STAY RIG

BOATSWAIN'S MATE THIRD CLASS (BM3)

34 SEAMANSHIP

34011 DISTRIBUTE AND ATTACH RUNNING RIGGING FOR HANDLING CARGO

34012 ERECT STATION MARKERS FOR REPLENISHMENT AT SEA

34013 SERVE AS SIGNALMAN FOR WINCHMAN OR CRANEMAN

34018 DETERMINE MECHANICAL ADVANTAGE OF TACKLE, USE, CARE, AND STOW RIGGING AND CARGO-HANDLING EQUIPMENT

34024 SERVE AS A MEMBER OF THE ANCHORING AND MOORING DETAIL

34031 DISTINGUISH CHARACTERISTICS AND USE OF NAVIGATIONAL LIGHTS AND AIDS

34036 PREPARE WOOD AND METAL SURFACES FOR PAINTING

34037 PREPARE AND APPLY PAINTS AND PRIMERS

34039 PREPARE AND USE STENCILS FOR PAINTING LETTERS AND NUMERALS

34047 HANDLE AND CARE FOR NATURAL FIBER, SYNTHETIC, AND WIRE ROPES. MAKE A BOAT FENDER, TIE A REEVING LINE BEND, WALL KNOT, DOUBLE MATTHEW WALKER. ROLLING HITCH, TIMBER HITCH, FISHERMAN'S BEND, MARLIN HITCH, 3-STRAND TURK'S HEAD, SINGLE BOWLINE ON A BIGHT, BARREL HITCH, AND BLACKWALL HITCH. SPLICE AND MAKE EYE SPLICES IN NATURAL FIBER, SYNTHETIC FIBER, AND WIRE ROPES.

BOATSWAIN'S MATE THIRD CLASS (BM3)

34 SEAMANSHIP—Continued

34049 REEVE A SINGLE SHIP, RUNNER, LUFF TACKLE, TWOFOLD PURCHASE, DOUBLE LUFF, AND THREEFOLD PURCHASE

34050 BREAK-OUT AND FAKE-DOWN HAWSERS AND WIRE ROPE

34052 USE TERMINOLOGY COMMON TO GROUND TACKLE, RIGGING, HOISTING, STOWING

34053 DISTINGUISH TYPES, WEIGHTS, USES, AND CARE OF CANVAS AND LEATHER; CANVAS WATER-PROOFING; COMMON CAUSES OF DETERIORATION OF CANVAS AND LEATHER

34058 OPERATE VARIOUS TYPES OF LANDING CRAFT

34067 SERVE AS BOAT COXSWAIN; PREPARE FOR LOWERING AND HOISTING AND, IN THE USE OF LANDING CRAFT, PREPARE FOR BEACHING AND RETRACTING

34068 READ, AND CARE FOR BOAT COMPASS, APPLY VARIATION AND DEVIATION TO DETERMINE COMPASS COURSE FROM TRUE COURSE OR TRUE COURSE FROM COMPASS COURSE; USE CHART TO DETERMINE COMPASS COURSE TO DESTINATION; MAINTAIN COMPASS LOG BOOK

34070 IDENTIFY CLASSES AND CAPACITIES OF BOATS, EQUIPMENT CARRIED BY SHIP'S POWERBOATS, LCVP'S AND LCM'S

34071 USE BOAT HAILS AND RECALLS, BOAT SALUTES AND BOAT ETIQUETTE

BOATSWAIN'S MATE THIRD CLASS (BM3)

34 SEAMANSHIP—Continued

34072 CONDUCT MINOR INSPECTION AND MAINTENANCE OF BOATS INCLUDING INFLATABLE LIFEBOATS

34073 IDENTIFY EFFECT OF PROPELLERS, RUDDER, WIND AND CURRENT WHEN MANEUVERING A SMALL BOAT IN A RESTRICTED SPACE

34410 DISTINGUISH CHARACTERISTICS AND USE OF NAVIGATIONAL SOUND SIGNALS

34411 INTERPRET RULES FOR AVOIDING COLLISION IN MEETING, CROSSING AND OVERTAKING SITUATIONS

34412 INTERPRET DISTRESS SIGNALS

34413 INTERPRET MEANING OF THE GENERAL PRUDENTIAL RULE AND THE RULE OF GOOD SEAMANSHIP

34414 USE THE THUMB RULES TO DETERMINE SAFE WORKING LOADS FOR LINE, WIRE AND TACKLE, DETERMINE SIZE OF LINE OR WIRE TO HOIST GIVEN LOAD

40 FABRICATION AND MANUFACTURING

40001 OPERATE AND ADJUST A SEWING MACHINE FOR SEWING CANVAS

40511 PATCH CANVAS, USING FLATSTITCH, ROUNDSTITCH, AND HERRINGBONE STITCH, HANDSEW SMALL CANVAS ARTICLES USED ABOARD SHIP, AND HANDSEW ROPES AND METAL FITTINGS TO CANVAS

BOATSWAIN'S MATE THIRD CLASS (BM3)

42 GENERAL WATCHSTANDING

42024 STAND WATCH AS BOATSWAIN'S MATE OF THE WATCH, AT SEA AND IN PORT, PASS WORD AND PIPE SHIPBOARD CALLS

62 AIRCRAFT HANDLING AND AVIATION SUPPORT

62001 DIRECT HELICOPTERS USING STANDARD HAND SIGNALS

86 COMMUNICATIONS

86049 INTERPRET SIGNAL FLAGS AND PENNANTS, RECOGNIZE AND KNOW MEANING OF STORM WARNING SIGNALS

86050 SEND AND RECEIVE SEMAPHORE AND FLASHING LIGHT

94 MECHANICAL MAINTENANCE

94004 MAINTAIN AND OVERHAUL BLOCKS, TACKLES, AND STANDING AND RUNNING RIGGING

94592 SHARPEN SCRAPERS AND CHIPPING HAMMERS

94593 DISASSEMBLE, CLEAN, REASSEMBLE, ADJUST, AND STOW PAINT-SPRAYING AND SURFACE-PREPARATION TOOLS AND EQUIPMENT. CLEAN AND DISINFECT RESPIRATORS

94633 LUBRICATE DECK MACHINERY

There are additional requirements for advancement to each pay grade up through E-9, Master Chief Boatswain's Mate (BMCM). The qualifications required of the most senior boatswain's mate, include the factors for BMCM given below.

34 SEAMANSHIP

34082 COORDINATE AND DIRECT THE OFF-LOADING, LAUNCHING, LOWERING OF ALL BOATS AND LANDING CRAFT CARRIED ABOARD SHIP, UNDER ALL OPERATIONAL CONDITIONS

34083 COORDINATE SALVAGE AND RESCUE OPERATIONS

35 ADMINISTRATION

35483 PLAN, ORGANIZE, IMPLEMENT AND CONTROL ACTIVITIES IN COMPLIANCE WITH POLICY STATEMENTS, OPERATION ORDERS, AND DIRECTIVES

35489 FORECAST FUTURE REQUIREMENTS AND PLAN AND INITIATE ACTION TO SATISFY REQUIREMENTS IN OWN AREA OF RESPONSIBILITY

35490 ESTABLISH GOALS, OBJECTIVES AND PRIORITIES IN OWN AREA OF RESPONSIBILITY

35492 REVIEW PERSONNEL, EQUIPMENT AND MATERIAL REQUIREMENTS

50 MAINTENANCE PLANNING AND QUALITY ASSURANCE

50045 ADMINISTER THE DEPARTMENTAL LONG-RANGE PLANNED MAINTENANCE PROGRAM

52 FINANCIAL CONTROL

52298 DEVELOP OPERATING BUDGETS AND MONITOR EXPENDITURES

These are high qualifications, and it is a proud man who develops them.

DECK DEPARTMENT SPACES

Each division aboard ship must maintain the preservation and cleanliness of parts of the exterior and interior of the hull, hull fittings, machinery, and equipment. The deck divisions are responsible for the following spaces

1. Main deck, superstructure, and overheads, bow to stern.
2. 01, 02 weather decks, etc., as assigned.
3. Stack(s) up to watch cap line.
4. Ship's boats, davits, boat booms, and storage areas.
5. Accommodation and sea ladders.
6. Hull; waterline to main deck.
7. Peak tanks.
8. Boatswain's storeroom

12. Paint locker.
13. Deck gear locker.
14. Deck division living compartments and heads.
15. Miscellaneous passageways, fan rooms, gear lockers, etc.

WATCHES

SHORE STATION WATCHES

Security is the term used for protection from spies, sabotage, theft, surprise attack, fires, and so forth.

You must be alert at all times to protect the Navy and its property from any sort of damage. When you are assigned to a security watch, you devote your full attention to guarding some object, person, or place. This type of duty includes sentry duty, fire watches, guard duty, and barracks watches.

Sentry duty is the most military and requires set procedures on your part. Guard duty may be the same as sentry duty, or you may be allowed to relax your military bearing as long as you are in the right place and ready for action. A fire watch may mean a steady patrol on foot, or it may simply mean staying in a building or area during certain times. A person on a barracks watch may be expected to stand a sentry watch, or may be called on only to answer the phone, turn lights off and on, take messages, and preserve order and cleanliness in the barracks.

BARRACKS SECURITY WATCH

A security watch is maintained in the barracks for protection against fire, for the safety of personnel and material, and for carrying out routines. A security watch stander is responsible for knowing and applying the provisions of the fire bill, barracks regulations, and the like.

The security watch must maintain the standards of order and of discipline.

Instructions differ, but in most cases, a watch stander must know the name and telephone extension of the duty officer. The OOD (Officer of the Day) should be notified at once in case of fire, illness, accident, or unusual circumstances.

In the event of fire, the watch stander should carry out the orders of the station fire bill. This bill requires him or her to sound the station fire alarm, warn any personnel endangered by the fire, and direct the firefighting personnel to the scene of the fire.

OFFICE TELEPHONE WATCH

At home, ashore, and at sea the telephone is a part of the lives of everyone It is an important item in every Navy office, and you must know how to use it properly By observing proper techniques, you will be able to give and receive information correctly and quickly. Remember that the success of a telephone conversation depends almost entirely upon your ability to express yourself in words When speaking to a person directly, your facial expressions, gestures, and the like, all aid in getting your point across.

Good telephone technique starts with answering your telephone as promptly as possible Do not let it ring several times while you finish what you are doing. After lifting the receiver, you should speak immediately to the person calling. Identify yourself when answering the telephone; usually the person making the call will tell you who he is.

Do not go on talking to someone in the office as you answer the telephone. You never know who your caller may be, and information given out in this way could be harmful to national security. Also, it is discourteous to make the caller wait while you finish your office conversation.

When you answer the phone for someone who is absent from the office, give some facts to the person making the call. Do not merely say, "He's not in right now." Tell the caller when you expect the person to return, or offer to help him if you can. If you have no information concerning the whereabouts of the person called, ask the caller if you may take a message.

Always make sure you have a pencil and pad beside the telephone for taking messages. Also, it is worth remembering that the message will mean little to the person for whom it is intended unless you leave him the following information (1) name of the caller, (2) the message, (3) time of the message, and (4) your name.

Sometimes you may have to leave the telephone to obtain additional information for a call. When this delay is necessary, you should make it known to the caller If it takes more time to obtain the required information than you expected, give the caller progress reports, as "I'm sorry I didn't find it there. If you don't mind waiting, I'll look elsewhere."

When making a telephone call, there are certain rules you should observe. First of all, be sure that the number you dial is the correct one. When you dial wrong numbers, you waste other people's time as well as your own. Second, when making a call to another office, identify yourself immediately. If you make the call for another person, so inform the person at the other end of the line. This courtesy eliminates the need for him to question you in this regard.

If you make a call and are informed that the person called is not in, ask the person answering the telephone to take a message, if appropriate. You should ensure that the person to whom you are speaking understands the message, knows how to spell your name or the name of the person for whom you are making the call, and that he has your correct telephone number.

The tonal quality of your voice may or may not be subject to improvement. But, by speaking correctly and distinctly, you should have little difficulty in making yourself understood. Do not shout; it probably will not help, and is likely to hurt.

Some people become nervous when speaking over the telephone. They take a deep breath, start at the beginning of their notes and rush through to the end, all in the same breath. The person at the other end of the wire cannot absorb so much information so quickly. Do not race through a conversation. The person on the other end is just as anxious to hear your information as you are to give it to him. Avoid the need (and the waste of time) of having to repeat your message.

MESSENGER TO OOD

The duties of a messenger for the officer of the day are similar to those of the shipboard OOD messenger. These duties will be described later.

SHIPBOARD WATCHES

A Navy ship in commission can never be left unattended. The boilers must be kept fired; the water and electricity supply must be maintained; and the magazines and vital equipment must remain guarded. While at sea, the lookout stations, the helm, and other stations must be manned. All these functions must be on a 24-hour-a-day basis, not merely from 9 a.m. to 5 p.m., as may apply to office jobs ashore.

Civilian outfits that work at night are said to have two or three shifts. In the Navy the ship's force is divided into watches These watches follow one another and not only keep a ship in operation but also alert for possible action.

The term "watch" is used in several ways. Usually it is thought of as any one of the periods into which the day is divided, as in the list below.

0000 - 0400 . . Midwatch
0400 - 0800 . . . Morning watch
0800 - 1200 . . . Forenoon watch
1200 - 1600 . . . Afternoon watch
1600 - 1800 . . First dogwatch
1800 - 2000 . . . Second dogwatch
2000 - 2400 . . . Evening watch

The 1600 to 2000 watch is "dogged," that is, it is divided to allow the men to be relieved to eat their evening meal and to rotate the watches, as in the case of a three-section watch.

Watch sometimes refers to the location of the man on watch, as the starboard watch or the port watch. It may also refer to the section of the ship's crew on duty, or even to the man on watch, as the lookout watch.

Each man is assigned to a section of the watch. The sections are numbered. Small ships usually have three sections, large ships may have four. Thus, when word is passed that the first section (or the second, or the third) has the watch, each man in that section reports immediately to his watch station.

Watches must be relieved in ample time. Relieving on time does not mean at the exact minute the watch changes, but several minutes before–from 5 to 15 minutes, depending on the type of watch. This time difference is needed in order that the relief can get information and instructions from the man on watch. In the case of night lookouts, he must become adjusted for night vision.

When reporting directly to the person relieved, a man says "I am ready to relieve you." The man on watch then passes on to his relief any instructions or information about the proper standing of the watch When the relief is sure that he understands any instructions given him, he says, "I relieve you " He is completely responsible for the watch.

Five conditions of readiness govern the type of watch aboard ship A brief description of these conditions follows

- Condition I, or general quarters All hands are at battle stations.
- Condition II, or modified general quarters· Used only in large ships to permit some relaxation among personnel during periods when full condition I is not required.
- Condition III, wartime cruising· Usually only a third of crew on watch and only certain stations manned or partially manned.
- Condition IV, peacetime cruising Only necessary personnel on watch; remainder available for work and training.
- Condition V, peacetime watch in port. Enough personnel on board to get ship underway if necessary or to handle fires and similar emergencies.

SHIPBOARD IN-PORT WATCHES

The basic peacetime in-port watch organization is presented in this section. In emergency or in wartime, additional watches may be established.

Certain natural differences arise on board ship in carrying out guard and sentry duties. The terms sergeant of the guard and corporal of the guard, for instance, apply also to petty officers performing these duties. Some of the variations from guard duty ashore follow.

1. Where no marines are stationed, guard duty is performed by details from the ship's divisions and is known as the seaman guard.
2. The guard of the day is mustered at morning and evening colors and during the daylight hours when honors are to be rendered.
3. Sentinels do not challenge
4. The guard does not raise and lower the colors.
5. The guard, except the sentry in the brig post, is not responsible for the prisoners
6. The chief master at arms or his assistant has access to the prisoners at all times
7. The relief does not make the rounds of all posts as a unit when going on watch. Each post is relieved individually
8. The corporal of the guard visits sentinels at such times as may be prescribed by the commanding officer and as directed by the officer of the deck
9. No officer of the day is authorized. The officer of the deck has a corresponding function in his relation to the guard.

Pier Sentry

The pier sentry has duties in addition to those listed in the general orders for sentries. His

post probably will be at the head of the pier. From this point, he controls the incoming and outgoing flow of personnel and vehicles onto and off the pier. Because piers usually are crowded with working parties, it is the duty of the pier sentry to make sure that no horseplay or games are permitted on the pier.

Anchor Watch

The anchor watch is a ready working force that is available to the OOD for jobs that occur during the night. Also, the anchor watch may assist in matters of security. The number of men assigned to the anchor watch varies from ship to ship and according to type.

Side Boy

You will study honors and ceremonies, including side boys, gun salutes, and display of the ensign, in *Basic Military Requirements.*

As a side boy, you stand your watch from 0800 to sunset, except at mealtime and during general drills. You wear clean dress uniform at all times, and you must be neat and military in appearance. You must keep handy to the quarterdeck at all times, so that you can hear the side boys' call on the boatswain's pipe. Figure F-34 shows the ceremony of tending the side.

When officers or civilian dignitaries who rate side boys are coming aboard, the Boatswain's Mate sounds one veer (same as the call for "Ease away" or "Walk back") for two side boys, two veers for four, three veers for six, or four for eight. The number of veers depends on how many side boys the visitor rates At the sound of the pipe, fall in smartly on the double in two ranks, facing each other to form a passageway at the gangway, and wait at "Attention." The Boatswain's Mate then sounds the call "Alongside" so as to finish just as the visitor's boat makes the gangway. During this pipe, you do not salute, but remain at "Attention."

The Boatswain's Mate then falls in to the rear of the rank of side boys forward of the gangway, and starts his call "Over the side" as the visitor's head comes in sight. At the first note of this call, you and the other side boys—in unison—salute smartly. You also drop from the salute, together, on the last note. (Nothing looks worse than a file of side boys not saluting in unison.)

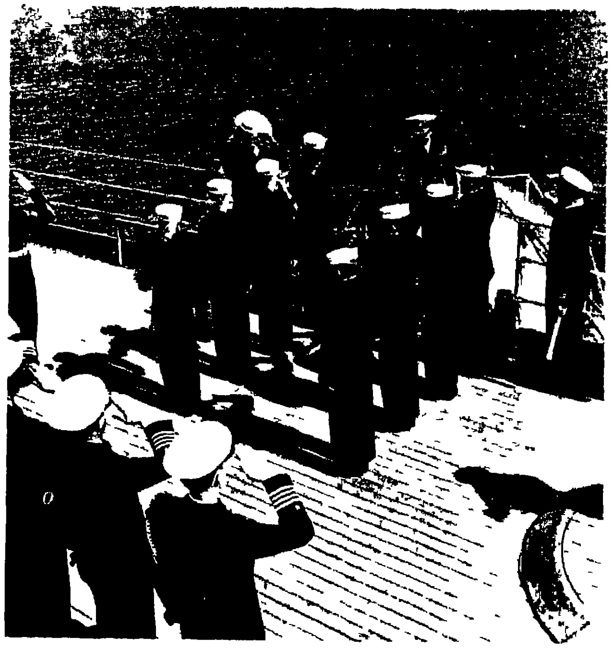

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Figure F-34.—Tending the side on a United States man-of-war.

When visitors are leaving, the side boys are again called by the boatswain's pipe. This time, however, the Boatswain's Mate immediately falls in with you and first sound "Over the side" as the visitor passes toward the gangway You salute on the first note, and drop to "Attention" on the last note. Remain at "Attention" while the pipe again sounds "Alongside" as the boat curves away. Do not break ranks from the gangway until you are released by the Boatswain's Mate. Never leave the vicinity of the quarterdeck without permission of the officer of the deck.

During these side honors, you may have the opportunity of seeing important people. Your close range, however, does not give you permission to stare at them as they pass Your eyes must always be kept straight ahead.

Most ships smaller than cruisers have side boy watches only on special occasions.

Messenger

Most messenger duty comes under the heading of messenger to the officer of the deck, commonly called OOD messenger. But you might be a messenger to a department head. In general, the duties are about the same

The first thing you must learn as a messenger is how to find your way around the ship. You must become familiar with the names and locations of the various parts of the ship. You must learn the department offices, the names and duties of the various officers and petty officers, and where to find them.

When you are given a message to deliver, be sure you know exactly where you are to go and what you are to say. On arrival, repeat the message in the exact words as told to you. Always carry messages directly and quickly. Wait until you are told there is no reply before returning to the sender.

Messages for the Captain or the Admiral should be given to his orderly for redelivery to the cabin.

Never return with the excuse: "I cannot find him, Sir." You must track down people who are not easy to locate. If you have to trail somebody all over the ship, you can explain the reason for your delay to the officer of the deck when you return.

Underway, your station as OOD messenger is on the bridge, in port, it is on the quarterdeck If the officer of the deck leaves the quarterdeck, you follow behind him at a short distance, to be available should he need you. While standing by on the quarterdeck, you lend a hand whenever needed. Also, you must keep the deck swept down and shipshape. If you have the morning watch, you scrub the gangway and polish the brightwork.

The general rules for the messenger are as follows.

1. Be in the prescribed uniform of the day at all times.
2. Be attentive to calls.
3. Carry messages directly and quickly. Return at once to the sender and report that his message was delivered.
4. If unable to deliver a message, report the fact at once to the sender.
5. If sent to an officer's room, KNOCK. Do not enter the room or open the door or curtain until told to do so.
6. Obtain permission before going to meals or to the head.
7. Never skylark, loll, or otherwise act in an unseamanlike manner.

Forecastle and Fantail Sentries

The forecastle and fantail sentries are placed at their stations to ensure good order and general shipboard security. These sentries prevent any person from boarding the ship at any spot except the quarterdeck. The forecastle and fantail sentries must be especially alert to repel any unauthorized boats from attempting to come alongside. Usually these sentries are furnished with arms. The forecastle and fantail sentries are also required to check the ship's mooring lines and make periodic reports to the officer of the deck.

Garbage Watch

The garbage watch is stood usually from reveille until 2000. This time may vary with individual ships. The man assigned this watch is stationed near the garbage containers on the pier His primary duties are to ensure that all garbage dumped ashore is separated and placed in proper containers marked either "Burnable Trash" or "Edible Trash " He also must see that the area is kept clean.

Captain's Orderly

Captain's orderly is the normal orderly duty The executive officer and department heads also may have orderlies. On orderly watch you will be in the limelight all the time. You must be especially neat and military, besides being particularly prompt and efficient in the performance of your duties.

Here are some general instructions for Captain's orderly. These are merely typical

orders, and may vary on different ships. Duties of other orderlies differ only in minor details.

1. Remain at all times in the vicinity of the cabin door, unless sent on an errand by the Captain.
2. Accompany the Captain whenever he leaves the cabin, unless otherwise directed by him.
3. Never deliver a message without a thorough understanding of what is desired.
4. Allow only persons authorized by the Captain to enter his cabin unannounced.
5. All messages from the bridge or radio room must be delivered to the Captain without delay, regardless of the hour, unless he gives orders to the contrary.
6. Carry out general orders for sentries on post.
7. Allow no one but the weapons officer or gunner to take the keys to the magazines from the cabin without special authority of the Captain. Report to your relief how many magazine keys are out. At 2000, report to the commanding officer whether all keys are in their places.
8. Hand over the order book to your relief in the presence of the petty officer of the guard or watch.
9. When visitors are on board, do not allow them to loiter in the vicinity of the cabin. Give necessary instructions courteously but firmly.

Time Orderly

Detailing one of the bridge messengers as a time orderly is a common practice. On some ships it may be stood as a separate watch. The orderly must be at the bell in time to sound off at the proper moment The bell is the ship's voice, so strike it smartly in short, sharp pairs, distinctly separated. It sounds slovenly if it comes over the water to other ships in lazy, uneven strokes

SHIPBOARD UNDERWAY WATCHES

A ship's peacetime underway watch organization is second in importance only to the organization for battle.

The personnel assigned to watch standing duties are entrusted with the safety and proper operation of the ship. In many cases, watch standers who failed to understand their responsibilities have caused a collision, grounding, and even the loss of a ship. There are many cases of record where serious damage and loss of life were avoided by the timely action of watch standers working together as a team.

Helmsman

The helmsman must be qualified by the navigator. An entry of such qualification must be recorded in his service record. The courses he steers must be prescribed by the conning officer.

The ability to steer can be attained only by practice. The first pointer to bear in mind is that the ship turns under the compass card, the compass card itself remains steady. When the card appears to be turning to the left of the lubber's line, it really is the line (and therefore the ship's head) that is moving to the right. On all modern ships the wheel, rudder, and ship's head all move in the same direction. To move the lubber's line and ship's head back to the left, then, you must turn the wheel to the left.

Steering a ship is not the same as steering an automobile To straighten your car on the road, you bring the wheel to 'midships position and keep it there. To straighten a ship that is swinging to the right, you probably will have to put your rudder left past the 'midships position, until she begins to straighten out. Then get it back to 'midships before the ship's head reaches the course on which you want to steady her. When you have her there, you will have to give her a touch of right rudder to steady her, and you must take the rudder off her before she starts to swing again.

A new helmsman usually begins by applying too much rudder This is a natural trait because, when he turns his auto steering wheel, his car immediately turns. The new helmsman turns the ship's wheel a few degrees, yet nothing happens. It requires a little time for the steering engine to operate, and for the ship to begin answering her rudder The helmsman, growing anxious after a few seconds, turns the wheel more and still more.

Eventually, the lubber's line starts to move. When it reaches the course desired, the helmsman puts the rudder amidships. But the good old ship keeps right on swinging. Hastily the helmsman puts on opposite rudder, and finds that he has to put on plenty before the swing stops. It finally does but starts again, more rapidly than before, in the other direction. Soon the wheel is going from hard over to hard over. The helmsman is becoming more frantic, and the ship's head is swinging back and forth. The wake leaves a trail like a corkscrew. If somebody does not notice this situation or the racket in the steering engineroom, the helmsman will be practically sculling the ship with her rudder all the way through his watch.

The effect of the rudder on a big ship is a delayed action; you do not see it right away. Even when you put on too much rudder, the effect is delayed. But when the swing begins, the effect of opposite rudder proves equally slow. Remember: the less rudder you use, the better, it takes a lot less rudder to start a steady ship turning than you think.

When the man you relieve turns the wheel over to you, the ship will be steady on the course. Find out from him how she is acting. Often, because of wind and sea conditions, she will be carrying rudder on one side or the other. In other words, with the rudder amidships, she always wants to go off in the same direction Watch her for a while and see what she does. Try to figure out how much rudder is required to catch her just before she goes off the course.

If a sea is running from aft, the ship may be yawing back and forth about the same number of degrees on either side of the course as each swell passes under her. If she is getting the sea on one of the quarters, she will be thrown off as her stern rises, and off again the other way as she drops into the trough.

You cannot prevent this kind of yawing, and it is useless to strain yourself and the steering engine in such an attempt. But you must learn to recognize when she actually starts to go off the course and put rudder on her to prevent it. Always remember: It takes a lot less rudder to head off a swing than it does to stop one that has started.

Have the ship steady on her course before you surrender the wheel to your relief. Do not turn it over in the middle of a swing. Give him the course, and tell him the compass or repeater you are steering by. If it is a gyro repeater, be sure you designate the correct repeater (if more than one), and give him the equivalent course you are to steer by magnetic compass if the gyro fails. If you are zigzagging, give him both the immediate course the ship is on and the base course she will follow when she ceases to zigzag.

Also tell your relief about any steering peculiarity you discovered, such as "Carrying a little right rudder. Carrying mostly left," and so on. Relay to him any order you received that still is standing, as "Nothing to the left. Steady on course 091," etc. If you are steering on a ship, or a range, or a landmark or light, point it out to him and be certain that he gets the right one. Before leaving the steering station, report to the officer of the deck the orders given your relief, as "Steering two seven eight by gyro, Sir Steady as she goes, Sir. Steering on the range, Sir."

Good steering gets the ship to its destination more quickly. Every seaman should make the best of every opportunity to learn to steer. When he is on a wheel watch, he should give all his attention to steering, no matter how experienced he is.

Lee Helmsman

The lee helmsman regularly relieves the helmsman When either the lee helmsman or the helmsman is not actually steering, he must stand his watch at the engine order telegraph Here, he rings up the conning officer's orders to the engineroom. He makes sure that all bells are answered properly

Life Buoy Watch

You may stand your life buoy watch near one of the life buoys, usually located on either quarter First, you must know how to let go the buoy, which ordinarily is done by tripping a lanyard.

When you hear the cry "Man overboard," you do not have to wait for orders before dropping your buoy. If the man went over

forward, on your side, he probably would pass directly under you. For that reason, be careful when you let go that you do not hit him with the buoy. Do your best to keep him in sight, and continue to call out loudly "Man overboard!" until you are sure that the officer of the deck has heard the word on the bridge.

Although a man does not go overboard from your ship very often, remember that many a man owes his life to fast work by a shipmate on a life buoy watch.

Lifeboat Watch

The ready lifeboat is likely to be a motor whaleboat, griped in to a strongback between the davits, ready for lowering. Usually one boat on either side is prepared in this manner, and the lee boat is the one you will use if you have to lower away.

The lifeboat crew is mustered at the beginning of each watch. Between musters you must remain near the boat You are absolutely forbidden to wander away without permission. The PO (Petty Officer) of the watch or the boat coxswain will tell you what your duties are–whether manning the boat, lowering, clearing falls, and so on. If he neglects to tell you, ask him.

Handling the lifeboat is important. It is dangerous work demanding expert knowledge on the part of every crewmember You must know what to do and how to do it.

Lookout and Telephone Talker Duties

Lookout duties are discussed in *Basic Military Requirements* The duties of a telephone talker, and the procedures used when using a sound-powered telephone are covered in BMR.

GROUND TACKLE AND DECK EQUIPMENT

Ground tackle is the equipment used in anchoring and mooring with anchors. According to the *NavShips Technical Manual*, it includes–

1. Ships' anchors.
2. Chain, wire rope cables, or cable composed of both chain and wire rope, for use with ships' anchors.
3. Chain cable appendages consisting of connecting shackles, detachable links, bending shackles, mooring shackles, mooring swivel, shackle tool sets, clear hawse pendants, dip ropes, chain stoppers, wrenches for chain stoppers, outboard swivel shots, chain cable jacks, mooring hooks, chain hooks, and anchor bar

ANCHORS

The anchor usually aboard Navy ships is the patent, or stockless anchor. The standard stockless anchor is shown in figure F-35.

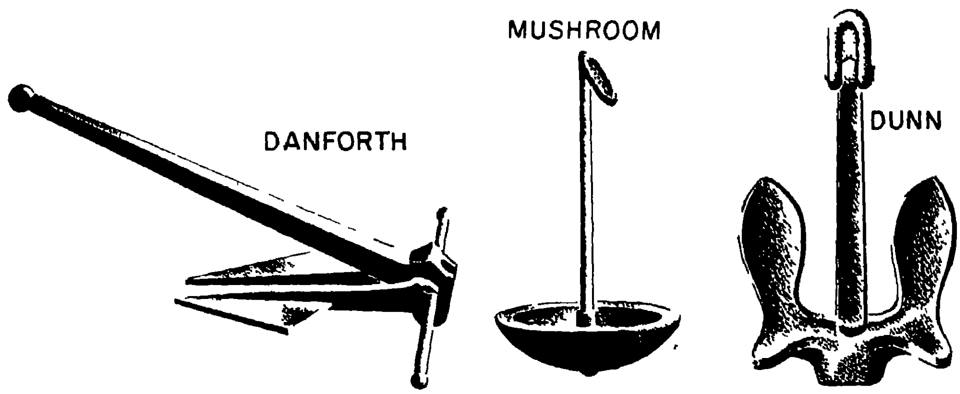

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Figure F-35.–Lightweight, mushroom, and stockless anchors.

Anchors usually are made of cast steel. The fittings and the shanks of housing anchors are made of forged steel They weigh from 30 pounds to 30,000 pounds. Their weight and a NavShips serial number and the date of manufacture are stamped on their crown or shank. Edges of anchors are smoothed to prevent damage to the ship's hull when hoisting.

A ship may carry bower, stream, stern, kedge, and boat anchors. These names come from the position or use of the anchor. They apply regardless of their type. Anchors are defined as follows:

- Bower anchor: This anchor, carried in the bow, is used for all anchoring except in unusual circumstances.

- Stream anchor An anchor of medium weight for miscellaneous use. It is called a stream anchor because in the past an anchor of this type was carried at the stern of men-of-war which frequently were required to anchor in rivers and other confined waters. Often it is necessary to secure the ship with anchors in both the bow and stern to prevent swinging.

- Stern anchor. Any anchor carried in the stern, regardless of weight or purpose

- Kedges. There are small anchors, usually of the Navy type, the heaviest weigh no more than a ton. They are intended for kedging, that is, moving a ship ahead a small distance at a time by taking one of the anchors out in a boat, letting it go, and then hauling the ship up to it. If kedging is done to change the heading of the ship, it is called warping.

- Boat anchors: Small Navy-type anchors for use in boats. Some lightweight anchors (e.g., Danforth) are also used.

CHAINS AND APPENDAGES

Modern Navy anchor chain is made of dielock or high-strength welded stud steel links. The size of the link is designated by its diameter, called wire diameter. The *Federal Supply Catalog* lists standard sizes from 3/4 to 3-1/2 inches. Wire diameter is measured at the end, a little above the centerline of the link. The length of a standard link is 6 times its wire diameter, and width is 3.6 times its diameter.

All links are studded, that is, a solid piece is either forged or welded in the center of the link. Studs eliminate the danger of the chain kinking and the pounding of links on adjacent links.

The following descriptions should acquaint you with details of anchor and appendages.

- Standard shots: The lengths of chain that are connected to make up the ship's anchor cable are called shots. A standard shot is 15 fathoms in length. Each shot of the chain usually bears a serial number stamped, cut, or cast at the time of manufacture on the inner side of the end links of each shot. If an end link is lost or removed from a shot, this identification number should be cut or stamped on the inside of the new end link of the altered shot.

- Detachable links At one time, shots of anchor chain were joined by an ordinary U-shaped shackle called a connecting shackle The connecting shackle was replaced by the Kenter shackle, which, in turn, was replaced by the detachable link shown in figure F-36. The Navy-type detachable link consists of a C-shaped link with two coupling plates, which form one side and stud of the link A taper pin, which holds the parts together, is locked in place at the large end by a lead plug Because detachable link parts are not interchangeable, matching numbers are stamped on the C-link and on each coupling plate for identification and proper assembly.

- Shackle tool sets Tool sets (often called unshackling kits) are provided in wood or metal boxes for use in assembling and disassembling detachable links. These sets are issued for specific sizes of chain. They include a hammer, punches, leadlocking plugs, and space taper pins

- Bending shackles Bending shackles are used for attaching the anchor to the chain cable.

- Chain swivels Chain swivels are furnished as part of the outboard swivel shot. Their purpose is to minimize kinking of the anchor chain. (Refer to fig. F-37.)

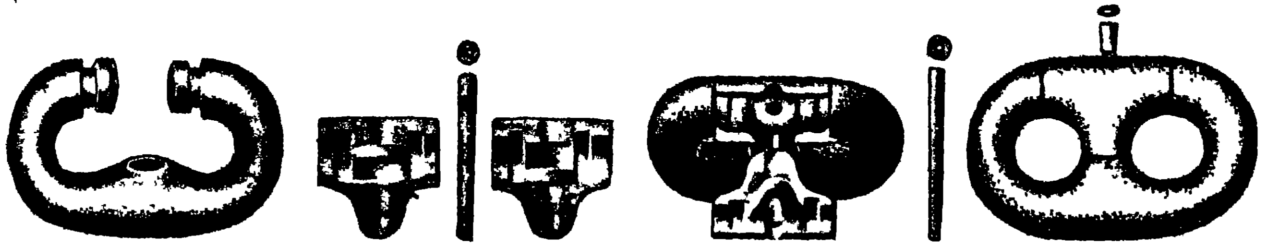

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Figure F-36.—Detachable link.

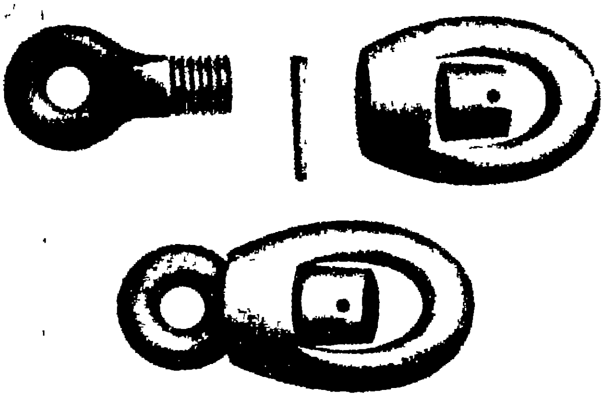

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Figure F-37 —Anchor swivel

● Outboard swivel shots Standard outboard swivel shots, also termed bending shots, consist of detachable links, regular chain links, a swivel, end link, and bending shackle. These swivel shots are fitted on most vessels to attach the anchor cable to the anchor They also make it possible to stop off the anchor and break the chain between the windlass and the anchor. They vary in length up to approximately 5 fathoms. Taper pins in the detachable links in the outboard swivel shot are secured with a wire-locking clip. Long and short outboard swivel shots are shown in figure F-38.

● Riding and housing chain stoppers: Riding and housing chain stoppers are made up of a turnbuckle inserted in a short section of chain. A slip or pelican hook is attached to one end of the chain, a shackle at the other end. The housing stopper is nearest the hawsepipe, the riding stopper is farther aft. These stoppers are secured by the shackles to permanent padeyes on the vessel's deck. Chain stoppers are used for (1) holding the anchor taut in the hawsepipes, (2) riding to an anchor, or (3) holding the anchors when the anchor chain is disconnected for any reason. When in use, a stopper is attached to the anchor chain by straddling a link with the tongue and strongback of the pelican hook. When riding to anchor with more than one stopper on the chain, the strain must be equalized in the stoppers by adjusting the settings of the turnbuckles Large chain stopper wrenches are issued for this purpose Special housing chain stoppers, such as devil's claw or pawl-type stoppers, usually are used with horizontal-type windlasses and where space limitations do not permit use of Navy standard stoppers. Stoppers alone should not be relied upon for holding the anchor Upon anchoring, the wildcat brake band should first be set up tight, then the stoppers secured The wildcat should be left disconnected from the engine A Navy standard chain stopper is shown in figure F-39.

● Mooring shackles Forged steel shackles are used for attaching the anchor chain to mooring buoys. All regular mooring shackles, regardless of size, have a standard mortise

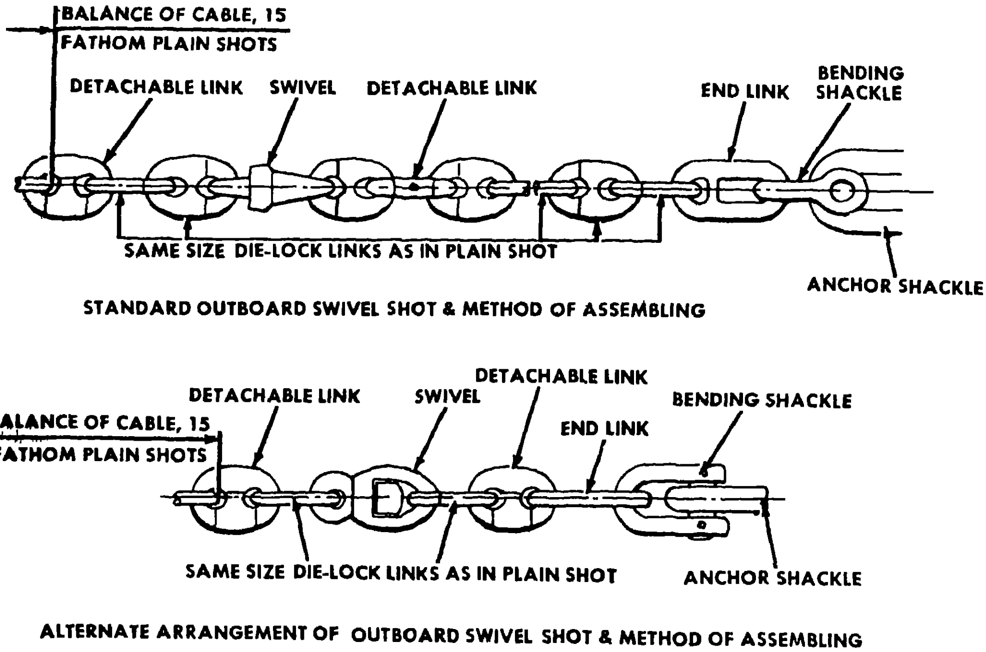

Figure F-38.—Long and short outboard swivel shots.

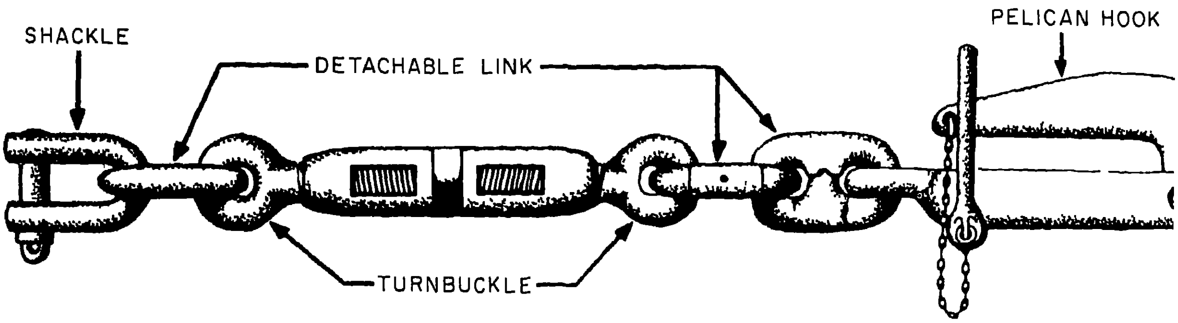

Figure F-39.—Navy standard chain stopper

(opening) of 6 inches Special mooring shackles, with 7-inch mortises and a clear inside length of 12-1/4 inches, have been authorized for use by cruisers when mooring to buoys in the Mediterranean area.

- Mooring swivels Forged steel s\ with two links attached at either end, are u mooring with anchors. They are inserted chain outboard of the hawse, and serve tc the chain from twisting as the ship swin;

prevent them from hooking on the outer lip of the hawse when they are heaved back aboard, the mooring swivels should be attached in the chain with the eye end outboard or down. Today, however, most ships have large, rounded lips on the hawsepipes, so it is unlikely that a reversed swivel will catch. A mooring swivel is shown in figure F-40.

- Mooring hooks: Mooring hooks, issued to destroyers and some other small vessels, are used for mooring to a buoy.

- Chain cable jacks: A cable jack, consisting of a lever mounted on an axle and two wheels, is used for handling anchor chain in sizes 2-3/4 inches and above. An anchor bar of the pinch-point crowbar type is issued for chain of smaller sizes.

- Clear hawse pendants: A wire rope pendant, 5 to 15 fathoms long, with a thimble at one end and a pelican hook attached to a length of open link chain fitted in a thimble at the other end, is used in clearing a hawse fouled by the anchor cable. (See fig. F-41.)

- Dip ropes A fiber rope pendant 14 to 36 fathoms long, fitted at one end with a thimble and a dip shackle large enough to engage a link of the anchor chain, is provided for use in mooring or clearing a hawse. (See fig. F-41)

- Chafing chain or pendant Inserted between the anchor and the anchor buoy line is a short length of chain and/or a wire rope pendant. The chain/pendant prevents the anchor buoy line from chafing on the anchor and parting.

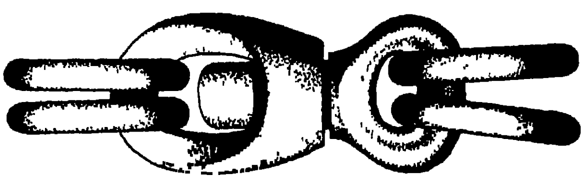

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Figure F-40.—Mooring swivel.

- Anchor chain markings· Anchor chains are marked as follows: The detachable links are painted red, white, or blue—

Red for 15 fathoms,
White for 30 fathoms,
Blue for 45 fathoms;
Red for 60 fathoms,
White for 75 fathoms; and so on.

At the 15-fathom mark, one link on each side of the detachable link is painted white and

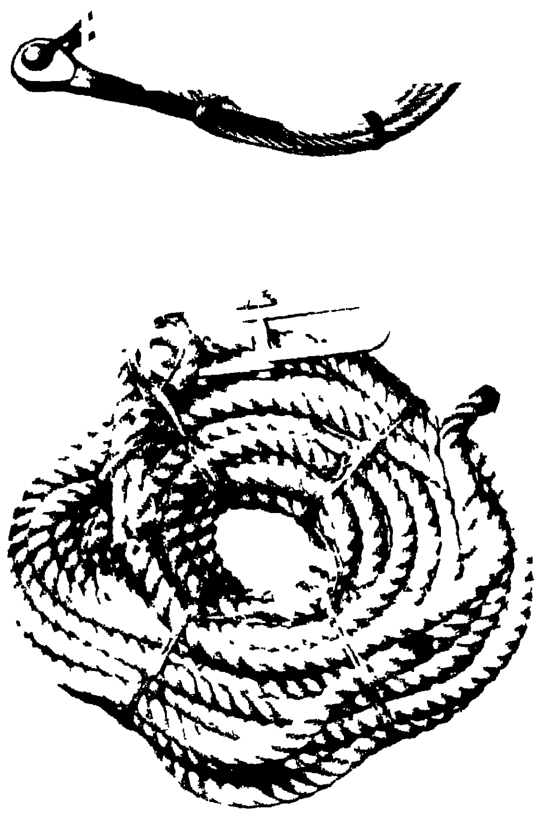

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Figure F-41.—Clear hawse pendant and dip rope.

one turn of wire is wrapped securely around each stud. At the 30-fathom mark, two links on each side of the detachable link are painted white, and two turns of wire are wrapped around the studs of the second links from the detachable link. At 45 fathoms, three links on each side of the detachable link are painted white, and three turns of wire are wrapped around the studs of the last white links. At 60 fathoms, four white links are on each side, and four turns of wire are wrapped around the last white studs. (And so on for each shot.)

Each link of the entire next-to-last shot is painted yellow; the last shot is entirely red. These last two shots give warning of the approach of the bitter end of the cable.

ANCHOR WINDLASS, CAPSTANS, AND DAVITS

ANCHOR WINDLASS

An anchor windlass is the engine used to hoist a bower anchor; stern anchors are handled by a stern anchor winch. There are two types of windlass the vertical shaft type used on most combatant ships, and the horizontal shaft type used on most auxiliaries and merchant ships

The basic principle of operation is the same for both types of windlass The method of letting go and of securing the anchor differs Also, the fact that a vertical shaft windlass usually is much farther aft than a horizontal shaft windlass causes a certain difference in the makeup of the chain

All windlasses used to be powered by steam On auxiliaries, many windlasses still use steam power Some small combatant ships have all-electric windlasses, but most vertical shaft windlasses are now powered by an electro-hydraulic mechanism.

Figure F-42 shows a vertical shaft anchor windlass. On this type, the only parts above the deck are the brake handwheel, engine control, capstan head, and wildcat. The rest of the machinery is located below in the anchor windlass room. Communication between the deck and the windlass room is by speaking tube or telephone.

For use with the wildcat in heaving on lines, the capstan head (a part of the shaft) is disengaged. The wildcat, just below the capstan head, contains teeth that engage the links of the anchor chain. By turning the locking handwheel in the windlass room, the wildcat may be engaged to or disengaged from the shaft. Turning the handwheel engages a locking head on the shaft with another attached to the wildcat. When the wildcat is engaged, starting the engine will either heave in or walk out the chain.

To prevent the wildcat from rotating when it is disengaged, the friction brake may be set up by the brake handwheel. With the brake off and the wildcat disengaged, the wildcat can rotate even if the shaft does not.

Most large combatant ships have a separate anchor windlass for each bower anchor. Some small ships, like DDs and DEs, have a single anchor windlass. It is equipped with some way of removing one bower anchor's chain from the windlass and connecting that of the other.

The horizontal shaft windlass is depicted in figure F-43. On this type, all the machinery is above the deck. Two wildcats are on the shaft-one for each bower anchor. Each wildcat may be locked to the shaft. Or it may be unlocked to rotate independently of the shaft and of the other wildcat. On this type of windlass, the locking head is engaged or disengaged by means of a thrust cam The thrust cam is shifted by a quarter turn with an iron bar that fits into a slot on the cam.

Letting Go

In preparing to anchor, all but one of the stoppers are slipped, and the brake is released so that the anchor is supported by the remaining stopper. If there is a long space between the anchor and the wildcat, a few links of cable are roused up on deck. If the ship is anchoring in deep water, the anchor may be walked out slowly by the engine. An order is given to stand clear of the chain. It is important to obey this order because nothing will stop an anchor cable that parts or whips. There is a possibility that everything on the forecastle may be wiped clean. On the command "Stand by" the toggle is taken out of the pelican hook and a man stands by

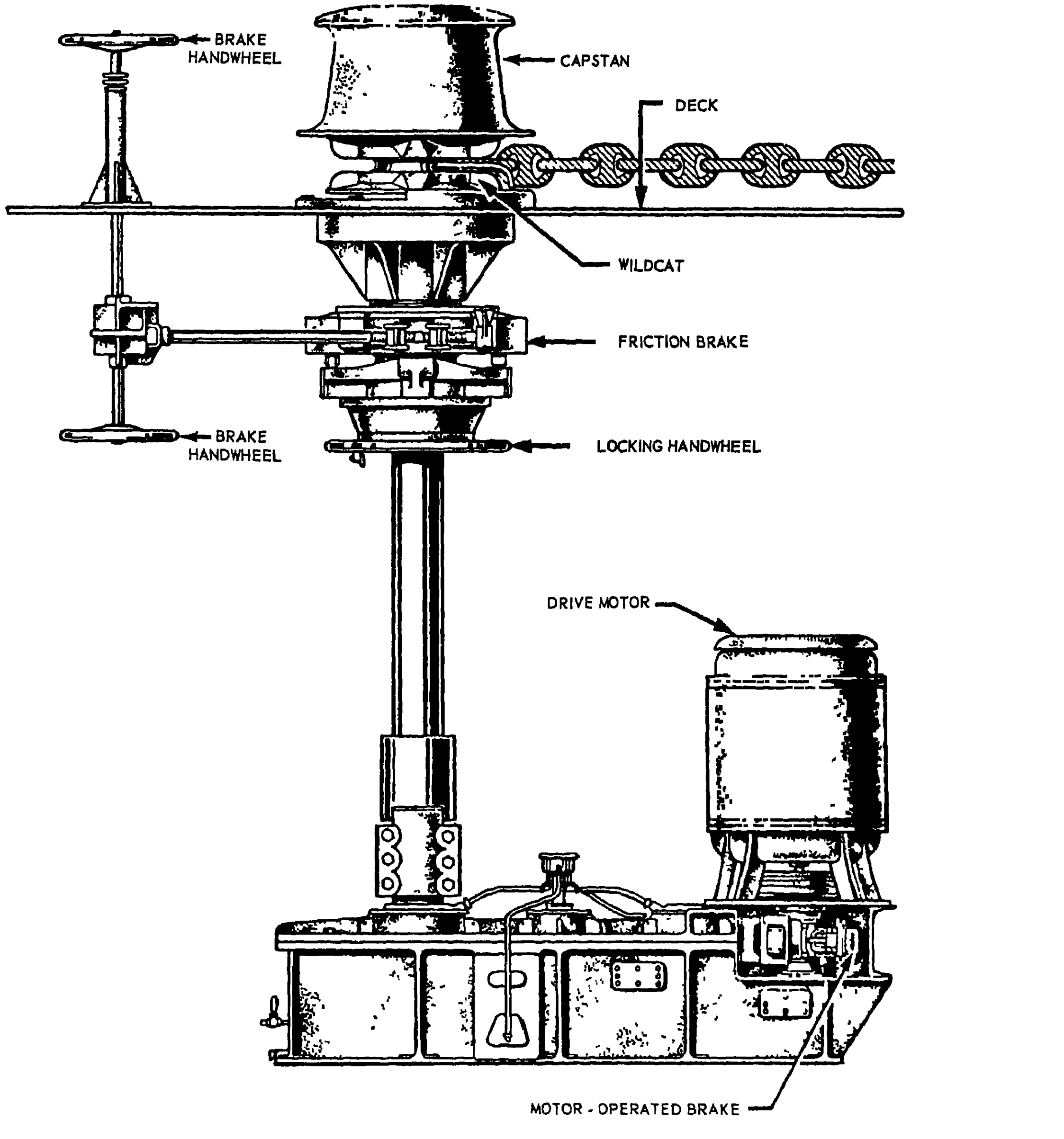

Figure F-42.–Vertical shaft anchor windlass.

with a sledge. On the order "Let go," the pelican hook is knocked open with the sledge.

As the chain runs out, a report is made of the amount, strain, and its angle relative to the bow, as: "Thirty fathoms on deck, sir; chain tending at six o'clock; no strain." ("Tend" is used as a verb with chain to state the direction of the chain relative to the bow. The direction the chain tends is given as hours of the clock.) Cable payed out usually is equal to about 5 to 7 times the depth of the water One anchor with a long scope (amount) of chain has better holding qualities than two anchors, each with half as much chain. A short scope causes a pull on the anchor that may loosen the flukes.

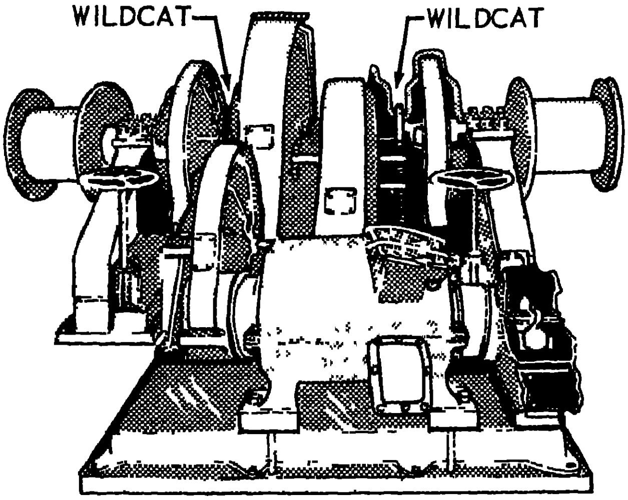

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Figure F-43.—Horizontal shaft windlass.

A small anchor buoy is attached to the crown of each anchor by a light line. An anchor buoy shows the actual position of the anchor to which it is attached by floating above it. Each buoy usually is painted a different color (green for starboard anchor, red for port anchor, and white for stern anchor). If an anchor buoy floats on the surface, it is said to be watching An anchor buoy may fail to watch because its line is too short or is fouled in the chain, or the tending line may be cut on dropping the anchor. Before anchoring, the line attaching the buoy to the anchor should be adjusted to a length that is a couple of fathoms greater than the depth of water at the anchorage. The extra length allows for slight fouling, variation of the tides, or sinking of the anchor in mud. There should not be so much spare line on the anchor buoy that is much more than the depth of water at the anchorage. The anchor buoy and line must be laid up along (and outboard of) the lifelines It should be put overboard, or streamed, well clear of the ship the instant the anchor is let go

An anchor buoy is a valuable timesaver in locating an anchor lost in weighing or one that slipped in an emergency. Slipping an anchor means intentionally allowing either the bitter end of the chain to part, or that section outboard of a disconnected shackle to run out. Slipping an anchor happens when unforeseen circumstances do not permit time to weigh anchor.

Weighing Anchor

Before hoisting the anchor, the engine is warmed up, if of the steam type, and tested (regardless of type). The wildcat is then engaged with the shaft, the brake released, a strain taken on the chain, and the stoppers cast loose. Before the time set for getting underway and after the main engines are tested, the anchor usually is heaved in to short stay—a condition in which there is no more chain out than is necessary to keep from breaking out the anchor (pulling the anchor loose from the bottom). Heaving short is done only on order of the officer of the deck. He usually designates the amount of chain to be taken in as "Heave around to 10 fathoms!" "On deck! (or waters edge)"

When ready to get underway, the anchor is heaved in as ordered from the bridge The amount of chain out is reported to the bridge from time to time. Orders may be received to heave in to any number of fathoms or to heave right up In any event, report usually is made when markers are at the water's edge (Example "Fifteen fathoms at the water's edge, sir," when the anchor is at short stay, up and down, aweigh, in sight, and secured or ready for letting go) The anchor is up and down when the stock is pulled up from the bottom, but the crown is still touching. The action of the chain shows this condition of the anchor It is judged either by the officer in charge of the forecastle or by the Boatswain. With the report "Anchor in sight" goes one regarding its condition, as "Anchor in sight, sir, clear (or foul) anchor"

As the chain comes in, a hose is played on it to remove mud. Usually, the markings are repainted. Some links of each shot are tested by striking them with a hammer. All links are tested if the chain was subjected to a heavy strain. If a link rings, it is all right, but if it sounds flat, the first lieutenant or the Boatswain should be notified immediately.

Stowing Chain

As the chain comes aboard, it passes along the deck, over the wildcat, and down into the chain locker. Each chain goes into a bin, as shown in figure F-44. Its bitter end is secured to a ring bolt on the bulkhead of the bin. In ships with shallow chain lockers, one or more men are detailed to the chain locker to tier the chain (lay it out so that it does not clog the chain pipe).

Securing

If the anchor is of the stockless type, it is housed in the hawsepipe, as shown in the upper part of figure F-44. It is secured in the same manner as a riding chain. The anchor must be drawn taut in the hawsepipe by the outboard stopper to prevent the flukes from banging against the sides. Stoppers (fig. F-45) are attached to the chain by straddling a link with the tongue and link of the pelican hook. The

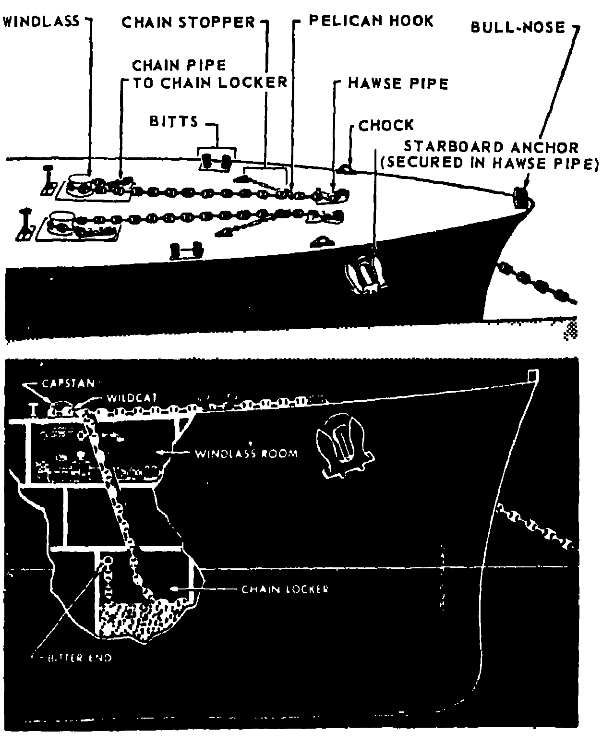

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Figure F-44.—Stowage of chain.

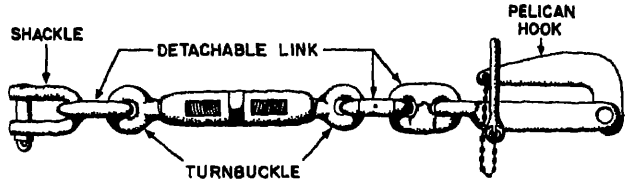

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Figure F-45.—Chain stopper, pelican hook, and turnbuckle.

turnbuckles must be so adjusted that each stopper will take an equal strain. The toggle that keeps the pelican hook closed must then be inserted in the tongue of the pelican hook.

Frequently it is necessary to block up the chain so that the stopper may catch a particular link, thus avoiding large adjustments of the turnbuckle This adjustment is made because (1) it is absolutely essential that a strain be taken by the stopper, and (2) changing the set of a large turnbuckle is hard work.

CAPSTANS

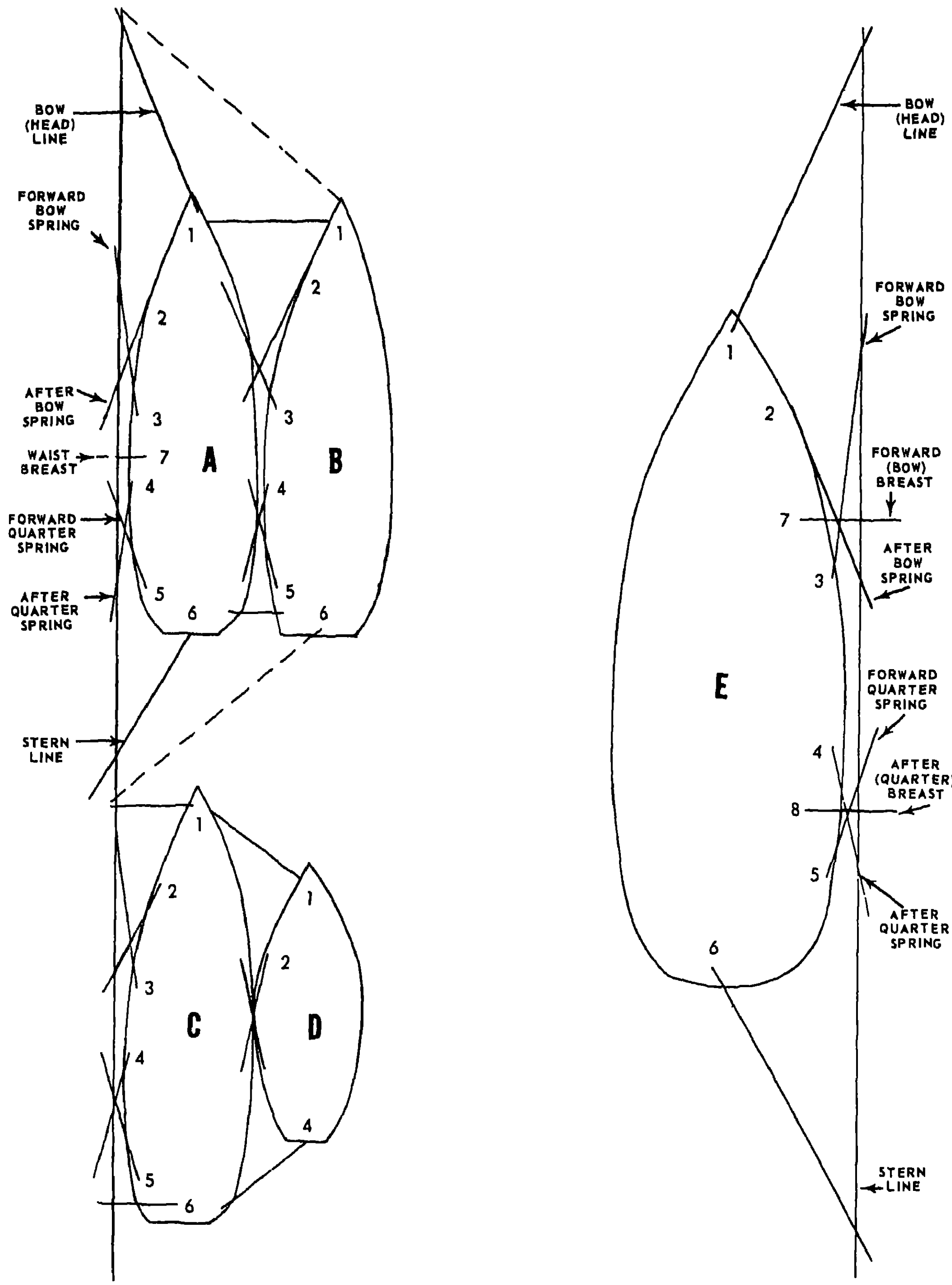
Capstans are mounted on deck to handle large, heavy mooring lines and wires These capstans may be separate machinery units, as usually seen on tug boats, or they may be part of the anchor windlass, as on most Navy ships (fig. F-42).

The essential feature of the capstan is the vertical spool-shaped drum, fitted with pawls. Whelps or ridges on the drum are provided to keep the lines from slipping, especially when wet

Capstans are powered by either steam or electricity On small ships (such as minesweepers), they also may be operated by hand in an emergency

MOORING A SHIP WITH LINES

A ship is moored when she is made fast to a mooring buoy, when she is swinging on a bight of chain between two anchors, or when she is secured by lines alongside a pier or another ship. The lines used in mooring a ship alongside a pier are illustrated in figure F-46.



1 BOW LINE
2 AFTER BOW SPRING
3 FORWARD BOW SPRING
4. AFTER QUARTER SPRING
5 FORWARD QUARTER SPRING
6. STERN LINE
7 WAIST BREAST

1 BOW LINE
2 AFTER BOW SPRING
3. FORWARD BOW SPRING
4 AFTER QUARTER SPRING
5. FORWARD QUARTER SPRING
6. STERN LINE
7 FORWARD (BOW) BREAST
8. AFTER (QUARTER) BREAST

3.227

Figure F-46.—Mooring lines.

Bowlines and stern lines usually are longer than the others. They run directly from the bow and stern, respectively. Well in advance of mooring, the lines should be faked down, fore and aft (if practicable), each near the chock through which it passes. The end with the eye should be passed through the chock and the loop laid back on the lifeline.

The bowline and forward springs prevent the ship from drifing astern. With sternway on, both these lines, when secured, tend to breast the ship in.

The stern line and after springs prevent the ship from drifing forward. With headway on, both these lines, when secured, tend to breast the ship in.

The forward and after breast lines prevent the ship from drifing away from the pier.

DECK FITTINGS

Deck fittings consist of such devices as cleats, bitts, bollards, chocks, and towing pads. A brief description of each is listed below.

1. Cleat A cleat is a device consisting mainly of a pair of projecting horns used for belaying a line or wire (fig. F-47).

2. Bitts Bitts are cylindrical objects made of cast iron or steel (fig. F-48). They are arranged in pairs, each pair mounted on a separate footing, which in turn is welded or bolted to the deck. Usually there is a set of bitts forward and abaft each chock. They are used mainly for belaying mooring lines.

3. Chock A chock is a heavy fitting, with smooth surfaces through which mooring lines are led. Mooring lines are run from bitts on deck through chocks to bollards on the pier when the ship is mooring. Chocks are three types:

a. Open chock· A mooring chock, open at the top (fig. F-49).

b. Closed chock: A mooring chock, closed by an arch of metal across its top (fig. F-50).

c. Roller chock: A mooring chock that contains a roller for reducing friction (fig. F-51).

4. Bollard A bollard is a strong cylindrical upright on a pier, around which the eye or bight of a ship's mooring line is thrown (fig. F-52).

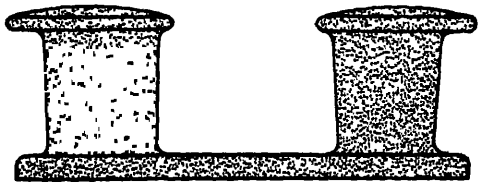


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Figure F-48.—Bitts.

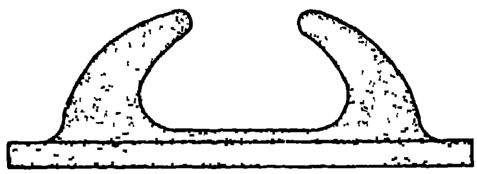

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Figure F-49.—Open chock.

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Figure F-47.—Cleat.

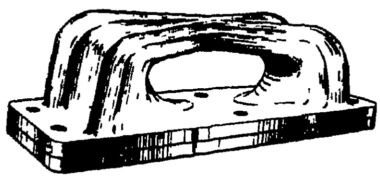

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Figure F-50.—Closed chock.

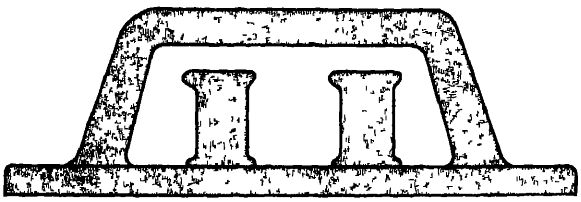

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Figure F-51.—Roller chock.

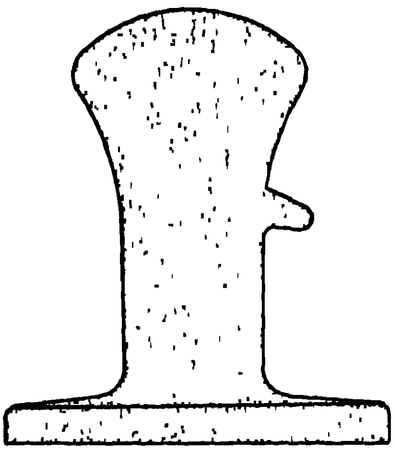

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Figure F-52.—Bollard.

5. Towing pad A towing pad is a large padeye that is welded to the deck. (See fig. F-53.) It is used in towing operations.

DECK SAFETY

Lines must never be made fast to capstans or gypsy heads, but only to fittings provided for that purpose—such as cleats or bitts. When hawsepipe covers are removed for any purpose, a safety guard must be installed forward of each hawsepipe to prevent personnel handling lines from stepping or falling into the opening. When heaving around or veering the anchor cable, only authorized personnel may remain on the forecastle. In letting go the anchor, the brake operator must wear goggles while handling the brake.

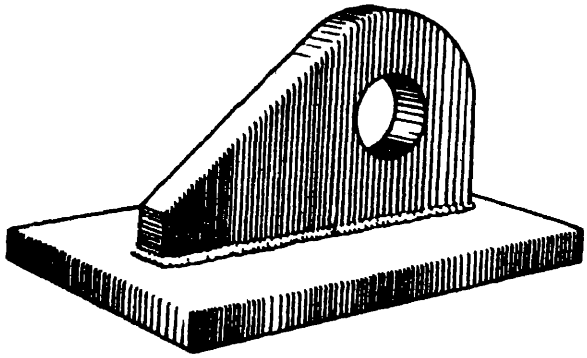

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Figure F-53.—Towing padeye.

CRANES, CAPSTANS, WINCHES, AND WINDLASSES

Only personnel who have been instructed in their duties and who have been authorized by the first lieutenant are permitted to operate cranes, capstans, winches, and windlasses. Except in an emergency, operation of the machinery must be supervised by a responsible officer or petty officer. The method of operation and all necessary special instructions must be posted at the place of operation

Experienced personnel must always supervise the topping and lowering of booms Before making any repairs or replacing any of the gear, booms should always be lowered on deck

RING BUOYS AND LIFELINES

Ring buoys with a line and light attached must be available for use when a sea ladder or a Jacob's ladder is being used.

Personnel are not permitted to sit or lean on the lifelines at any time When lifelines are removed for any purpose, officers and petty officers concerned are required to ensure that emergency lines are rigged and that everyone is cautioned to keep clear. In port, when personnel are working over the side, they are required to wear lifejackets at all times. In addition to his lifejacket, when the ship is underway and a man has to work outside the lifelines, he is required

to have a safety line attached, properly tended by someone on deck.

KNOTTED LINE

A line often is secured temporarily by a knot, round turn, figure eight, riding turn, or other means other than a splice. In such cases usable strength of the line is reduced by some 50 to 60 percent, although the line may be suitable for lashing or securing a light, or steady a load where tension is not applied by power equipment, it should not be used under sudden or heavy loads.

Figure eight bends on cleats or "H" bitts have the same effect as a knot-effective rope strength is reduced by one-half or more.

SMOKESTACKS

Except in cases of emergency, personnel are not permitted to perform work on the smokestack when a ship is underway. If that work must be done, precaution must be taken to prevent blowing tubes, lifting safeties, or blowing the whistle. Boatswain's chairs are used rather than stages. A brass warning plate, in plain sight, is attached to all smokestacks, cautioning personnel about the poisonous gases and fumes therein.

Other aspects of shipboard safety not discussed here are adequately covered in *Basic Military Requirements.*

PART G

DRILLS, COMMANDS, AND CEREMONIES

In this section, you will learn about military drill. You will learn how to march in organized units and how to respond to individual commands. By studying and practicing military drill, you develop leadership. You will learn to take orders, which builds an ability to give orders.

Every person in the Navy has practiced military drill at some time. Both in boot camp and officer training schools, close order drill is a common activity. Here, you will learn to drill as a squad, a platoon, and as a company. You will learn how to lead a military formation in close order drill.

The instruction is composed of six parts:

Individual instruction
Military drill, squad, close order
Military drill, platoon, close order
Military drill, company, close order
Rotation of command
Review by company officer

What you learn here will form the basis for later studies and practice in military drill and leadership.

The basic text material for this section is located in Chapter 6 of *Basic Military Requirements,* NAVEDTRA 10054-D. All materials will be found there, with the exception of company drill which appears on the following pages.

COMPANY DRILL

A company consists of a company headquarters and two or more platoons. For close-order drill and ceremonies, company headquarters personnel may be attached to platoons without interfering with the permanent squad organization. For marches, members of the company headquarters command group are formed as shown in figure G-1. The group may also be directed by the company commander or higher authority.

Posts of officers, key noncommissioned (petty) officers, and the guidon bearer in the various company formations for drills and ceremonies are as shown in figures G-1 through G-5. Distances are normal except for the guidon bearer when the company is in line or in mass formation. In this case, he or she is one pace to the rear and three paces to the left of the company commander. For marches in the field, the guidon is kept with company headquarters baggage or as otherwise directed. If carried by the guidon bearer, the position as shown in figure G-1 is taken.

RULES FOR COMPANY DRILL

The platoon is the basic drill unit. These formations are prescribed for the company as necessary for marches, drills, and ceremonies. The company forms in line, in column, in mass or extended mass formation, and in columns of platoons in line as shown in figures G-1 through G-5. In company drill, if all persons in the unit are to perform the same movement at the same time, the platoon commanders repeat all preparatory commands of the company commander except:

(1) Commands such as FALL OUT. These combine the preparatory command and command of execution.

(2) When the preparatory command of the company commander is COMPANY, the platoon leaders give the preparatory command PLATOON.

(3) When in mass formation, platoon commanders repeat preparatory commands only when the order will require independent movement by a platoon

(4) The platoons of the company may want to execute (perform) a movement in successive order, such as a column movement. The platoon commander of the first platoon executes the movement and repeats the company commander's preparatory command The following platoons give an appropriate caution, such as CONTINUE TO MARCH Platoon commanders of following platoons repeat the company commander's preparatory command. Then they repeat the command of execution at the proper time to cause their platoons to execute the movement on the same ground as the first platoon.

When commands involve movements of the company, one platoon may stand fast or continue the march, while one or more of the others do not. Its commander commands STAND FAST or CONTINUE TO MARCH, as the case may be. The company marches, executes change of direction, closes and extends intervals between squads in column. It also opens and closes ranks as in platoon drill. The

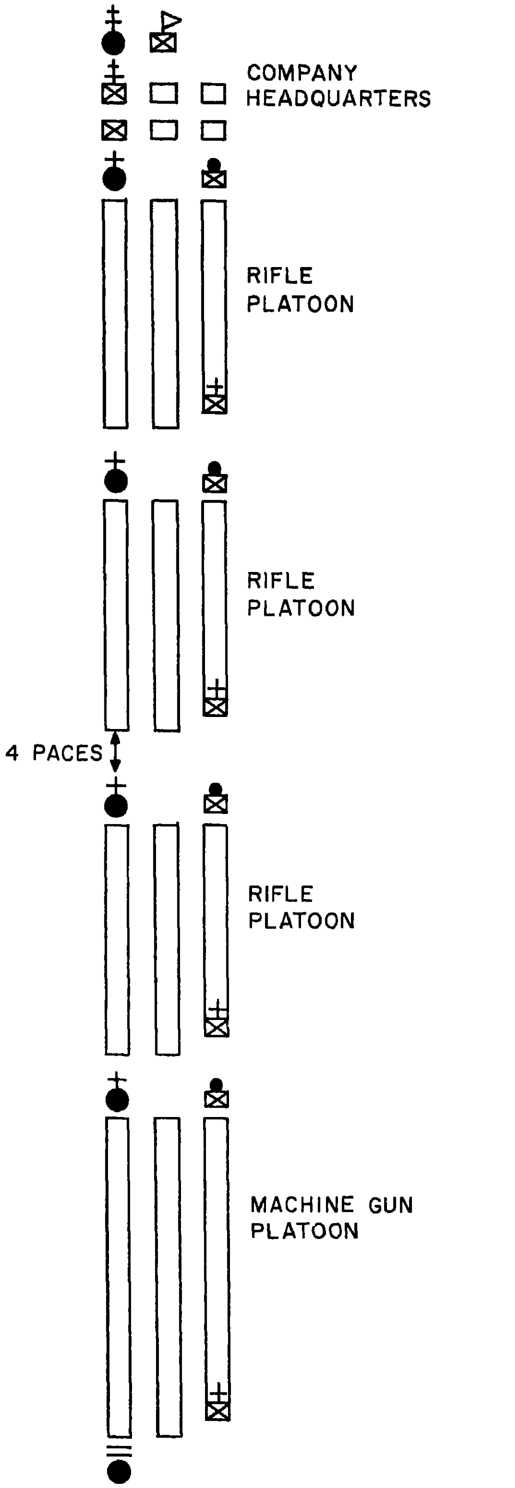

Figure G-1.—Rifle company in column.

company executes marchings in line only for minor changes in position.

TO FORM THE COMPANY

The first sergeant (chief petty officer) takes post nine paces in front of the center of the company. He or she faces that point, and commands FALL IN. At the command FALL IN, the company forms in two or more ranks. The form is the normal interval between persons (unless close interval is directed) and four-pace intervals between platoons as indicated in figure G-2.

Each platoon sergeant (petty officer) takes post three paces in front of the center of the platoon. Platoons then form under the supervision of the platoon sergeants (petty officers).

Platoon sergeants (petty officers) then command REPORT. Remaining in position, the squad leaders, in succession from front to rear in each platoon, salute and report, "All Present," or "Private (Seaman) ______ absent." The command REPORT is given by the first sergeant (chief petty officer). The platoon sergeants (petty officers), beginning with the right platoon, successively salute and report, "All present or accounted for" or "_ _ _persons absent."

All platoons having reported, the first sergeant (chief petty officer) commands POSTS. The platoon sergeants (petty officers) face about and move by the most direct routes to the positions shown in figure G-2. The first sergeant (chief petty officer) then faces the company commander, salutes, and reports, "Sir, all present or accounted for" or "Sir,_ _ _persons absent." The company commander returns the salute. He may discuss absentees and issue necessary instructions to the first sergeant (chief petty officer) The company commander commands TAKE YOUR POST. The first sergeant (chief petty officer) faces about and moves by the most direct route to the position shown in figure G-2. Upon completion of the first sergeant's (chief petty officer's) report, the company commander draws sword, if so armed.

If platoons cannot be formed in regularly organized squads, the platoon sergeants (petty officers) call the roll. Each person answers, "Here," as his or her name is called. The platoon

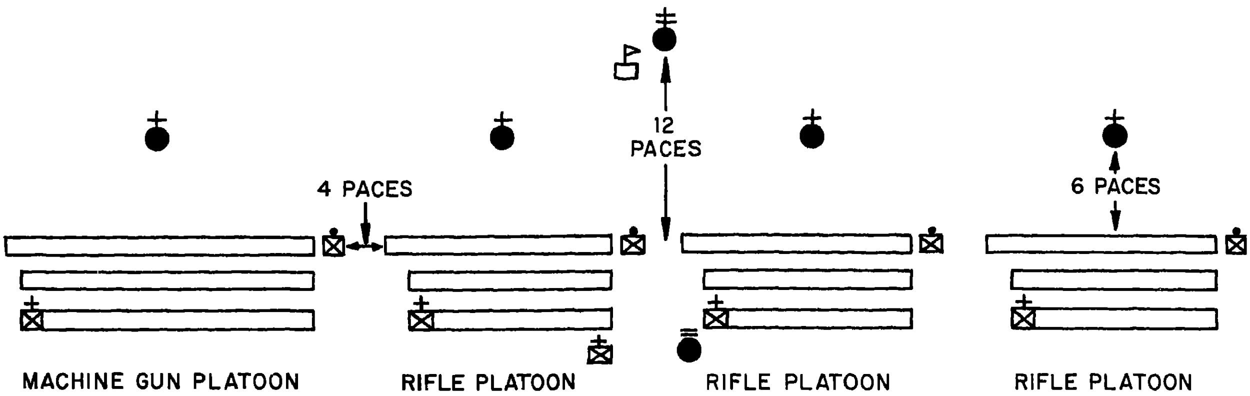

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Figure G-2.—Rifle company in line.

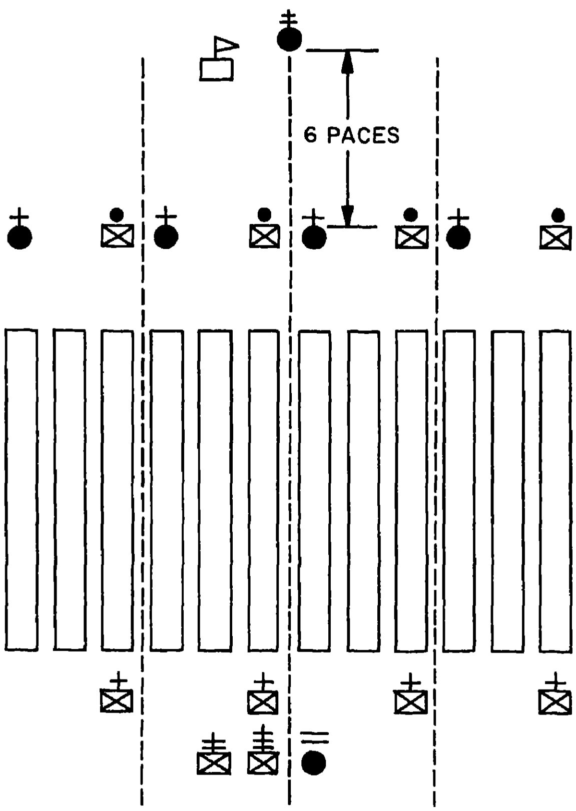

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Figure G-3.—Rifle company in mass formation.

sergeants (petty officers) then divide the platoons into squads and report as described above.

The company commander moves 12 paces in front of the center of the company and faces the company in time to receive the report of the first sergeant (chief petty officer) The second in command and officers commanding platoons take their posts when the company commander commands TAKE YOUR POST

In forming the company, all who are required to salute and make a report, report in the position of salute. They hold the salute until it is returned. The officer receiving the report does not return the salute until the report is completed.

BEING IN LINE, TO MARCH TO THE RIGHT (LEFT)

The company is faced to the right (left) and marched as prescribed for the platoon. The company commander, first sergeant (chief petty officer), and guidon bearer take positions as shown in figure G-1. The second in command of the company will take post in rear of the left squad of the rear platoon at 40 inches distance.

TO FORM WITH CLOSE INTERVAL BETWEEN MEN

The commands are AT CLOSE INTERVAL, FALL IN. At the command FALL IN, the

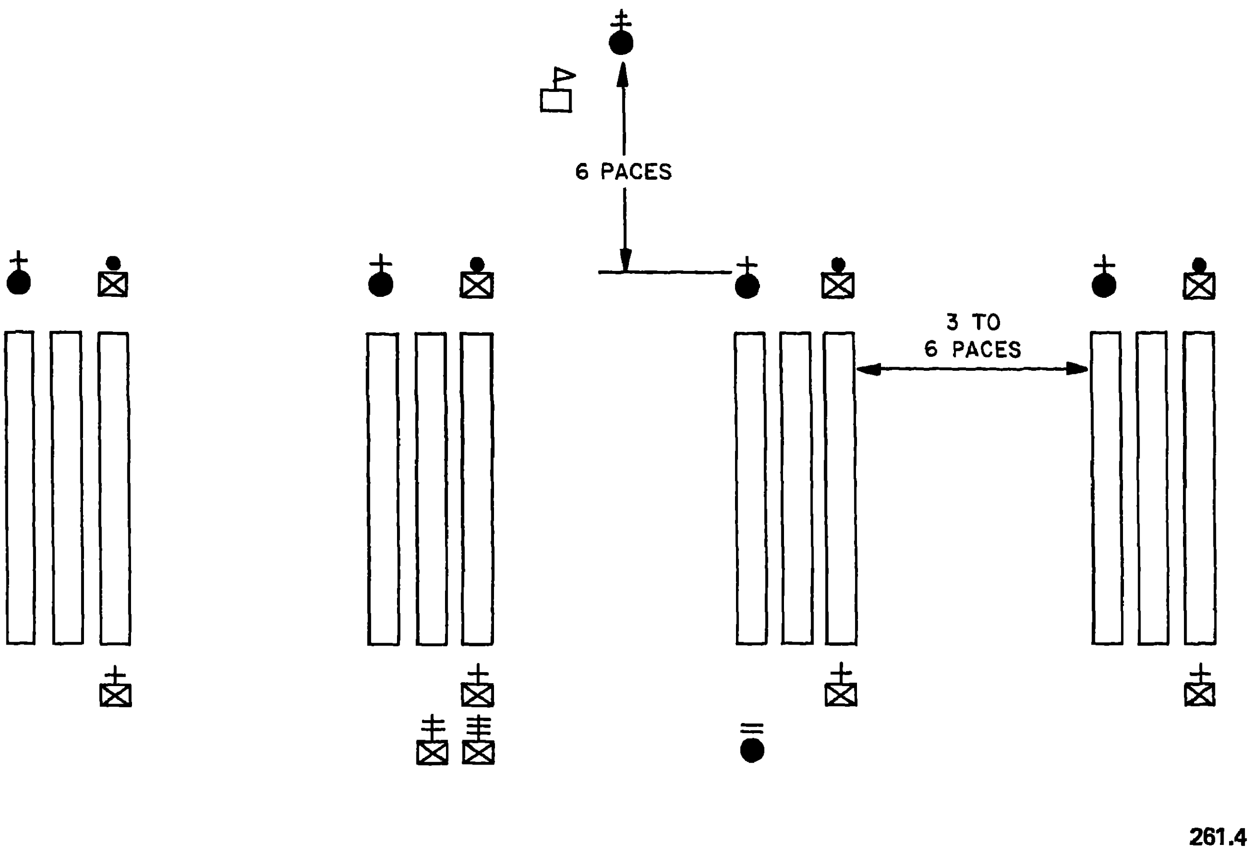

Figure G-4.–Rifle company in extended mass formation.

company forms with each platoon. This formation is used only for roll calls or where space is limited.

TO DISMISS THE COMPANY

The commands are FIRST SERGEANT (CHIEF PETTY OFFICER), DISMISS THE COMPANY. The company is in line at a halt. At the command FIRST SERGEANT (CHIEF PETTY OFFICER), the first sergeant (chief petty officer) moves by the most direct route to a point three paces from the company commander (nine paces in front of the center of the company), halts, and salutes. The company commander returns the salute and commands DISMISS THE COMPANY. The first sergeant (chief petty officer) salutes. The company commander returns the salute, returns sword, if so armed, and falls out. Other officers of the company return sword, if so armed, and fall out at the same time. The platoon sergeants (petty officers) take their posts three paces in front of the centers of their platoons. The first sergeant (chief petty officer), when the salute is returned by the company commander, executes about face. When the platoon sergeants (petty officers) have taken their positions, he or she commands DISMISSED.

The platoons being in line at a halt, dismissal may be ordered by the command DISMISS YOUR PLATOONS The platoon commanders salute and the company commander returns the salute and falls out. The platoon commanders execute about face and command PLATOON SERGEANT (PETTY OFFICER), DISMISS THE PLATOON. This is executed as prescribed for FIRST SERGEANT (CHIEF PETTY OFFICER), DISMISS THE COMPANY. The platoon sergeant (petty officer) takes his post three paces in front of the center of his platoon.

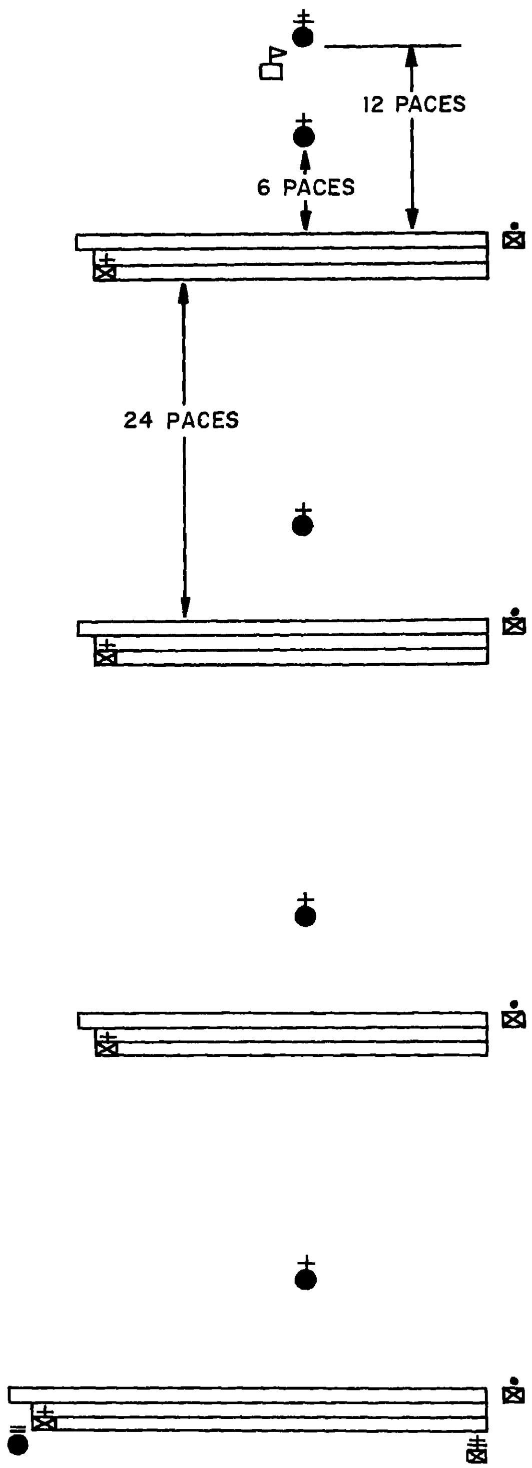

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Figure G-5.—Rifle company in column of platoons in line (with ranks closed).

The first sergeant (chief petty officer) may cause platoons to be dismissed by the platoon sergeants (petty officers) by commanding DISMISS YOUR PLATOONS. The platoon sergeants (petty officers) then execute about face and dismiss their platoons.

TO ALIGN THE COMPANY

To align the company, when the company is in line at a halt, the company commander commands DRESS RIGHT (CENTER, LEFT). At the command DRESS RIGHT, the platoon commander of the base platoon dresses the platoon immediately by the commands DRESS RIGHT, DRESS; READY, FRONT. When DRESS CENTER is given, the commander of the center platoon dresses the platoon toward the center (right or left) of the company. He or she does so when the platoon next to the base platoon has completed its dress.

To align the company in mass formation at a halt, the company commander commands AT CLOSE INTERVAL, DRESS RIGHT (LEFT), DRESS; READY, FRONT. At the command DRESS, the alignment of each rank is checked by the platoon commander of the base platoon. When the platoon commander goes back to the post, the company commander commands READY, FRONT.

BEING IN COLUMN AT CLOSE INTERVAL, TO FORM COMPANY MASS

When the company is at a halt, the commands are COMPANY MASS LEFT (RIGHT), MARCH. At the command MARCH, the leading platoon stands fast. The rear platoon(s) moves to positions alongside the leading platoon at 4-inch intervals. This is accomplished by executing column half left (right) then column half right (left) Platoon commanders give the necessary preparatory orders for the first column movement. Execution is on the company commander's command, MARCH. Both orders for the second movement are by the platoon commander Each platoon is halted when its leading rank is on line with the leading rank of the platoon(s) already on line. This forms the company in mass, with

4-inch intervals between all adjacent persons in ranks (fig. G-3).

With the company in march, the commands are the same as given above. One exception is that immediately after the command MARCH, the leading platoon is halted by the command PLATOON, HALT, given by the platoon commander.

BEING IN COLUMN, TO FORM EXTENDED MASS FORMATION

The commands are COMPANY MASS (3 to 6) PACES LEFT (RIGHT), MARCH At the command MARCH, the movement is executed. Now, the rear platoon(s) moves to position alongside the leading platoon(s) at the intervals ordered, by executing column left and column right. Each platoon is halted when its leading rank is on line with the leading rank of the platoon(s) already on line (fig. G-4). This formation is used for drills and ceremonies if it is desired to increase the size of the mass. It presents a more impressive appearance The company in this formation drills in the same manner as for mass formation, maintaining the interval between platoons.

BEING IN MASS FORMATION, TO CHANGE DIRECTION

The commands are RIGHT (LEFT) TURN, MARCH, and FORWARD, MARCH The right flank person of the line of guides and platoon leaders is the pivot of this movement. At the command MARCH, he or she faces to the right (left) in marching and takes up the half step Other first-rank persons execute a right (left) oblique advance until opposite their place in line. They execute a second right (left) oblique, and, upon arriving abreast of the pivot person, take up the half step Each succeeding rank executes the movement on the same ground and in the same manner as the first rank. All take the full step at the command FORWARD, MARCH. This command is given by the company commander after the entire company has changed direction.

In turning to the left on a moving pivot, each rank guides left until the command FORWARD, MARCH. After that, the guide is right unless otherwise announced.

The company commander faces the company and marches backward until the change in direction has been completed.

BEING IN COMPANY MASS, TO FORM COLUMN

When the company is at a halt, the commands are COLUMN OF FILES (TWOs, THREEs, OR MORE), RIGHT (LEFT) PLATOON, FORWARD (COLUMN RIGHT), MARCH. At the command MARCH, the right platoon marches forward. Each remaining platoon follows in column in its normal formation, executing column half right (left) and column half left (right) upon the commands of its commander.

When the company is in march, the commands are COLUMN OF FILES (TWOs, THREEs, OR MORE) FROM THE RIGHT (LEFT), MARCH. At the command MARCH, the right (left) platoon continues the march, and remaining platoons halt. When the leading platoon reaches an appropriate point, remaining platoons are brought to their appropriate places in column. This is accomplished by the commands COLUMN HALF RIGHT (LEFT), MARCH, COLUMN HALF LEFT (RIGHT), MARCH, given by platoon commanders.

TO FORM COLUMN OF PLATOONS IN LINE

With the company at a halt in columns of twos (threes, fours), the commands are COMPANY MASS 24, (10), (12), (6), PACES RIGHT, MARCH. On the preparatory command, platoon commanders give the command and step off on the command MARCH. This command is given by the company commander. When a platoon gains the interval (24, 18, 12, or 6 paces) ordered, its platoon commander commands COLUMN LEFT, MARCH. The platoon commanders of rear platoons command PLATOON, HALT, to halt their platoon on line with the base platoon. When all platoons are in position, the company commander commands LEFT, FACE He or she then directs platoon commanders to dress their platoons (fig. G-5). This formation may be used for inspections and for the display of equipment.

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